AGRICULTURAL ENGINEERING

JULY · 1948

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Drawbar Slack Solves TWO Spreader Problems

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"March of Machines"

Week of August 8-14

Wisconsin Centennial Exposition

Milwaukee

● Slack in the draft gear of a freight train enables a locomotive to start one car at a time, handle a heavier load. The same principle of divided inertia enables a light tractor to handle a Case Tractor Spreader with full load under more difficult conditions. Sliding action of the hitch gives the tractor an 18-inch headstart to establish rolling traction before nudging the spreader into motion.

The same sliding action serves as a wedge to lift the front of the spreader from low-loading position to level hauling and spreading position. Most helpful of all, this self-raising hitch permits hitching and unhitching from the tractor without any heavy lifting, any propping or jacking up. It cuts to seconds the time taken to turn from spreading to tillage.

Simple as a stove-lid, this sturdy hitch breaks down a major barrier to daily spreading — the secret of getting full measure of plantfood from farmstead to field. Quicker to hitch, lower to load, easier to "spot," surer to start, as well as fast on its rubber-shod wheels, a spreader so equipped saves time on every ton, encourages thin spreading to enhance the crop response per ton.

Thus does engineering of a few steel bars apply more plantfood per man-hour, take another step toward the goal of high yield per man. J. I. Case Co., Racine, Wis.

CASE . . .

AGRICULTURAL ENGINEERING

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RAYMOND OLNEY
Editor and Business Manager

EDITORIAL

Wherefore Private Enterprise?

SOUND, stable responsible men of high character who are anything but alarmists, are showing increasing concern over a trend of public opinion showing more people in favor of government ownership or planned economy and less supporting free enterprise.

Leonard J. Fletcher, a past-president of the American Society of Agricultural Engineers, is one of those who have gone beyond the stage of concern to develop some concrete suggestions as to how understanding of our economic and social life can be furthered, and the spread of misinformation, misunderstanding, and distrust reduced.

In brief, he suggests that responsible men start in their home communities, among their friends and neighbors, where the names of local private enterprises recall people rather than products. He suggests inviting consideration of facts by being a good listener; by swapping ideas, without argument, debate, or undue emotion; and by expressing those ideas in terms readily understood by the listener.

It is our impression that most engineers are strong believers in free enterprise. However, some of our readers may have occasion to swap ideas with a few engineers or others who lean with the wind.

George A. Rietz, in his address as retiring president of the ASAE (published elsewhere in this issue), presents several ideas on the subject to challenge the intelligent personal self-interest of every American.

It has seemed to us that the very meaning of private enterprise is often obscured in heat of argument and the smoke of invective.

Is enterprise anything other than active human effort stimulated by instincts, interests, beliefs, hopes, and desires within the individual? Can it have other than a private and personal source? Is it undesirable as a manifestation of life?

Can an economic and social movement take form and move without the application of private enterprise to the cause?

The soapbox orator, haranguing crowds about the evils of private enterprise—isn't he actually practicing private enterprise himself or furthering the private enterprise of his leaders? Or has this become an official government project of mystic, spontaneous, nonpersonal origin?

If personal private enterprise is the most effective force which cold, calculating dictators can find and utilize to satisfy their selfish lust for power, might it not also be a good force for us to continue to use in growing potatoes or building houses or automobiles?

If we do away with individual personal internal incentives to production, is there any alternative other than the external drive of the whiplash?

Doesn't history indicate that the abuse of private enterprise has been greatest when and where the freedom to exercise it was concentrated in the smallest numbers of people?

Can governmental or public enterprise or planned economy amount to more than the private enterprise of its leaders and their followers?

Can government be an effective mechanism for the stimulation of enterprise?

Can enterprise restricted to a few individuals, directing the activities of many, be more effective than free enterprise in promoting the best interests of the many?

Can you readily distinguish between the sincere enemy to abuse of free private enterprise, and the man who publicly deplores it, but is secretly ambitious to be among the leaders of such abuse, for personal gain at the expense of others rather than by his own economic production?

Have the leaders of various philosophies of government shown equally effective enterprise in the fields of physical production and the operation of economic services?

Will the American people patiently wait and work out their lives on promises through a succession of "five-year plans," while one political party applies the fruits of their production first to increasing its power, growth, and security against even the slightest criticism?

These are honest questions. If there is a new model in human motive power, superior to free enterprise, any of its salesmen can sign us up for one. But we want to see it demonstrated. We want the salesman to show its superiority by using it, to the complete exclusion of private enterprise on his or anyone's part, in selling it to us.

Mechanization in China

SOME factors favoring the mechanization of Chinese agriculture are brought out in the paper by James Y. T. Yu, published elsewhere in this issue.

One is that seasonal shortages of labor and animal power are common, notwithstanding the density of population.

Another is that there is considerable advantage to be gained, in yields and quality of product, by use of mechanical power to get critical jobs done at the best time from the standpoint of weather.

A third is that mechanical power could be used in slack periods to improve farm transportation, preliminary processing of farm products, and home craft industries, thus helping relieve farms of excess economic pressure.

Even so, it will be difficult to break out of the vicious circle of low productivity per man, high pressure on the land to produce minimum requirements for subsistence, and low opportunity for farmers to accumulate the capital means of improving their productivity.

The tractor and equipment combination which might do the trick would be a near-miracle in simplicity, low investment and operating cost, wide adaptability, high dependability, and high capacity to improve production per unit of land, as well as per man day.

It would have to justify its purchase and use primarily in increased salable produce from less than five acres in many cases, and that in scattered fields ranging down to 0.12 of an acre. In addition it should prove useful as portable stationary power and as road transportation. In many areas it should be able further to double as an outboard motor for canal junks.

That is a large order, from a design and manufacturing standpoint, but far from hopeless. Substantial progress in this same general direction is being made in the development of garden tractors for small farms in the United States.

Engineering attention to specific design requirements for mechanization of China's agriculture can be expected to produce results, sooner or later. It is an unusual opportunity for a specific type of machine to initiate the further enrichment of an ancient and honorable civilization which has shown remarkable vitality.

Profession-Wide Engineering

GADGETEERING opportunists and inventors with important original ideas perform a valuable function in turning up fields for sound engineering development. Individual engineers and the engineering departments of individual manufacturers carry on to make available many highly serviceable products. Sooner or later they reach a point at which it becomes clear that further progress will best be served by inviting profession-wide consideration of the progress and problems of any particular class of product in question. This is a natural cycle of engineering progress.

This wider engineering consideration of a class of products gives the individual manufacturers and their engineers at low cost the benefit of outside experience and thought on the common problems of their industry as to theoretical design, manufacturing considerations, utilization, and improved definition of use requirements. It provides inventors, individual engineers, and manufacturers' engineering departments with some new starting points and guides for further development.

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Opportunities for Agricultural Engineers

By George A. Rietz
MEMBER A.S.A.E.

AGRICULTURE is big business. Any business with an annual income of nearly $40,000,000,000 is big, even in this period of "box car" figures. In fact, agriculture is our largest industry. Each of the nearly 6 million farms is a small industrial plant producing, processing, and selling food. And how important food has become to all of us today! It has always been the basic industry in this country and every other country. Until the agriculture of any nation advances to the point that an abundant supply of good nourishing food is assured the year round, workers cannot safely go into other industries, professions, and services that make a nation great, with a high standard of living and highly developed sciences and arts.

GEORGE A. RIETZ
President, A.S.A.E., 1947-48

The point is that food doesn't come from the corner grocer or meat market, shoes from the shoe store, or woolen and cotton goods from the clothing store; any more than gasoline and oil come from the filling station, or steel goods come from the hardware store or automobile dealer. During normal times, we can readily purchase all these goods and many services such as electricity and transportation, because each is the product of an industry that has made it its business to supply modern society with the goods and services it needs. Without food, people can't work, and production of a sufficient food supply kept our early forefathers fully employed. As recently as 1800, three-fourths of our population was on farms, and, as Wheeler McMillen has pointed out, a farmer from ancient Rome was familiar with nearly every tool and farming method used on American farms. At that time, each bushel of wheat represented about three hours of hard work.

About 1850, reapers, mowers, and other horse-drawn implements appeared. By 1875, only half our labor force was required to produce food, by 1920, only one-fourth, and last year, only about one-seventh. It is possible for one farm worker in this country to produce food for 25 people today, whereas one farmer could feed only 16 people 25 years ago, because modern equipment and methods, which have been developed for him, make him a more productive worker. The bushel of wheat that represented three hours of hard work in 1800 represents only about 10 minutes of work today.

The agricultural industry in this country has progressed, at least during the past 35 years, in line with progress and efficiency in other industries. Agricultural engineers have played a major role in this record, and helped with the work of other groups in agriculture who have developed better seeds, feed, fertilizers, insecticides, and farm animals. During the past 35 years, the production per farm worker in this country has increased 98 per cent. During that same 35-year period, the output per American industrial worker has increased 92 per cent. So you can see that during the past 35 years, just about the life span of our American Society of Agricultural Engineers, agriculture has kept up with other industries in this country.

But agriculture still needs plenty of help from agricultural engineers. Fundamentally agriculture is a large user of power. Many are inclined to look merely at the gross income of farmers in this country. However, as engineers, we should continue to keep our eyes on another figure. That is the operating cost. You know that the profit of any business is the difference between what you take in and what you pay out. In 1946, it cost farmers in this country $18,000,000,000 to operate their plants. We know that this operating expense can be reduced materially by making farmers still greater directors of power, rather than generators of power, in handling many more of their farming operations. Maybe that term "director of power, not a generator of power" slides off readily without suggesting its significance. Mechanical and electrical power is one of the cheapest ways in which to buy work. For example, a 1/8-horsepower electric motor operating most any kind of farm machine will do the same mechanical work that a husky hired man can do. The motor will do that work at a cost of one or two cents an hour, so it is easy to see why the farmer, like workers in industry, should look upon power as an ally which he directs to produce more, in a shorter time, and to further reduce the drudgery of his job as well as the cost of accomplishing it.

Engineers have the reputation of not being satisfied with any method or piece of equipment we have. They are constantly looking for a better way. There are tremendous opportunities for agricultural engineers in this country to examine present farm equipment of all kinds and to carefully scrutinize the arrangement of farm buildings, tillage, and other farm practices. It is through such diligence and careful search and applying engineering knowledge to the specific problem, that we find constant improvement in existing methods and equipment, and the development of new and better equipment and methods. Agricultural engineers cannot be classed with the director of the U. S. Patent Office who resigned his job about seventy-five years ago stating that he was sure that everything that could be had already been developed and patented. He therefore wanted to get out of that job and into one that had a future. You all know how wrong he was, but his fundamental error was in his attitude. It would take a long time to list just some of the opportunities for improvement and fundamental work by agricultural engineers today. Everyone of you is in the midst of some stimulating, challenging job that is going to improve farming and farm living.

Let's analyze the necessary steps to sound progress and the place of the agricultural engineer's work in that picture. Any method or any equipment being used or recommended to farmers today, which is sound, must have gone through the following fundamental steps; likewise our new developments

Address of the President of the American Society of Agricultural Engineers before the 41st annual meeting of the Society at Portland, Ore., June 21-23, 1948.

GEORGE A. RIETZ is manager, farm industry division, General Electric Co.

in methods and equipment must meet the tests of these logical steps:

STEPS TO SOUND PROGRESS

1 Research
  Fundamental
  Objective
2 Engineering
  Development
  Application
  Product
  Testing
3 Manufacturing
4 Sale
  Education
  Closing sale
5 Profit to farm families
  Better farming
  Better living

Let us examine the four principal steps to the end of making it possible for farm families to progress further. The first step you will note is research. The purpose of research is to avoid remaking the same mistake by establishing the laws of behavior, so that processes can be laid out on a smooth working schedule, with confidence as to results. You might use different terminology to tag and identify various types of research, but let us use the term "fundamental research," which covers the seeking for new, not previously known information. Fundamental research is undertaken primarily because of an individual's curiosity, or a "hunch," or an attempt to resolve an apparent inconsistency in accumulated knowledge. The results of fundamental research are usually unexpected, almost always in the facts derived and almost invariably in the number of uses that can be made of the facts and the number of people who will benefit. A great deal of the research being carried on by public and private groups in this country is fundamental. It discovers the underlying facts and sets them forth clearly for someone to use to produce new, novel, or better combinations. Objective research, on the other hand, attempts to determine the facts associated with a particular problem that some engineer has probably bumped into.

Engineering involves working with known facts and known materials to do something new, novel, or better. This suggests that engineers must have facts. We have many, but always need more. Each new fact is not the end; it is only a terminal supplying a new starting place and probably opening up a whole new field of development. We hear this in connection with the atomic bomb, and electronics, and any one of a number of other new fields.

WHERE THE DEVELOPMENT ENGINEER FITS IN

A development engineer is a well-trained engineer who is able to take laws and facts and visualize the possibility of using them for some useful purpose. He probably constructs a "Rube Goldberg" machine in a laboratory to see if a law, such as the one of compressing gases and later allowing them to expand to give us our cyclic system of refrigeration, really can be used. He finds that it can, on a laboratory scale. He then goes to an application engineer who knows the requirements of some group—say, farmers. He helps to fit a known product or method to the needs of that group.

Many of our agricultural engineers fall in this classification because they know the needs of agriculture. They can set forth the requirements of this machine or method with regard to its size, probable price, capacity, whether it will be used in a building, outdoors, etc. With the development and application engineer cooperating, they concoct such a machine and try it out. In the process, they run into such problems as they did in refrigeration. This machine would work but it happened that the compressor bearings burned out. They found that normal oil in the presence of the refrigerants didn't do the job of lubricating. They went back to the objective research people to find the answer of how to make oil and the refrigerant get along together, so a practical machine could be built. Information has to feed back and forth between research and engineering groups as well as among them, nearly without end.

To make a long story short, they found the answer to their problem. A practical machine could be built. Then a product engineer was put on the job to design the machine to the finest detail, including the selection of materials from which it should be built, and the arrangement that made for lower-cost high-quality manufacture. After the machine was manufactured in some quantity, the testing engineer came in for his important job. It is important to be sure that the product will do what it is supposed to and that it is uniform in performance. Any company or any group that is concerned about its reputation and future will thoroughly test any new equipment before offering it for sale. This involves fundamentally trained men who have a full understanding of mechanical performance and needs.

For this paper, I am going to spend little time on manufacturing. Though it is as highly advanced an undertaking in this country as any, I need merely to say that, if any are of the opinion that a factory today consists of a building, into one end of which you pour a certain amount of steel and copper and insulating material, etc., and then dash around to the other end of the building to take out motors and engines and radios and refrigerators, you have an interesting and fascinating study in getting up to date on the present development of manufacturing techniques in this country.

Many may feel that sales have no place in an engineering discussion. However, we recognize that until the new methods or new equipment that have been developed and manufactured are in general use, they aren't doing the majority of potential users very much good. A tractor in the factory warehouse or the distributor's place of business, or even in a dealer's yard does no farmer any good.

It just happens that none of us automatically do what is good for us. You know Socrates was a philosopher who went around giving people good advice, and that they poisoned him. Many of our advance agents in education and selling are treated nearly as badly.

FIRST JOB OF SELLING IS EDUCATION

The first, and really most of the job of selling, is education. You must get the potential user, the person who should be putting your idea or equipment to work to his benefit, to clearly understand what your product will do for him and how completely he will benefit, so that he sees that the benefits are worth more than the price or the cost of his having it. Then any fair-minded citizen would act, wouldn't he? Education is 95 per cent selling, and as we have a large number of agricultural engineers in the educational field—as a matter of fact most of us are—I think it has a legitimate place in an agricultural engineering discussion.

After the prospect is educated and fully understands your proposal and sees that it is worth much more than it is going to cost him, the only remaining step in selling is to get him to say "yes." You do this in any one of a number of ways such as, "Well, Bill, you have the truck in today, do you want to haul it out, or shall I deliver it tomorrow?" Or "Bill, do you want to pay for it, or shall I put it on the bill?", and he says "Yes" and the sale is closed.

Now I don't want to seem to treat this lightly, because, as a matter fact, education and sales activity are really the spark plug that spur our research, engineering, and manufacturing groups on to greater efforts and results, and get the American public to generally adopt and thereby benefit from their developments. No new product or new process was ever brought out for which there was a ready, accepted market. Everything has to be sold.

One or two examples may refresh our memories on that point. Last year, 3,250,000 electric refrigerators were sold in this country. More could have been sold if they could have been made. But do you know how long it took all manufacturers to sell the first 75,000 electric refrigerators? Today, there is hardly a home owner who would think of living without an electric refrigerator in the kitchen. Yet it took all manufacturers and their (Continued on page 292)

A New Automatic Egg Washer and Drier

By Forrest B. Wright
MEMBER A.S.A.E.

THE cleaning of eggs by hand is a slow, tedious and unpleasant job, requiring time and energy that can be better spent at something else. In New York State, at least, many poultry farmers and their wives are spending two, three or four evenings per week in the basements cleaning eggs by hand. On large poultry farms, one or more employees spend full time cleaning and packing eggs.

At the instigation of the Department of Poultry Husbandry at Cornell University in 1943, a research project was set up in the Agricultural Engineering Department to locate, assemble, or design a mechanical egg cleaner that would relieve the farmer and his wife of this chore and materially reduce the labor cost of producing eggs for market.

The standards of performance and specifications for such a machine as set up by the Poultry Department were as follows:

1 It must thoroughly clean even the dirtiest eggs (on the ends as well as the sides)

2 It must clean in a sanitary manner, to preserve the keeping quality of the eggs

3 It must not damage the exterior appearance of the eggs. (This with special reference to markings or discoloration on brown eggs)

4 It must not damage the interior quality of the eggs

5 It should not remove the natural "bloom" from the egg shell

6 It should handle all sizes and shapes of eggs without adjustment

7 It must handle even the thin-shelled and blind-checked eggs without breakage

8 It must be faster than hand cleaning

9 It must be low in initial cost and in operating cost to make it available to poultrymen with as few as 500 birds.

Because of the practice of discounting washed eggs on some markets, the first step was to investigate the various mechanical sanders and buffers in use in the state. All of these failed in a number of ways to meet the above nine requirements. Many new and untried designs of sanders and buffers were tested with no better results.

At the suggestion of several leaders in the poultry industry, work was then started on wet washing machines as a possible solution. Reports from one of the largest egg receivers in New York City and from other research projects convinced us that it was not the washing as such that was objectionable, but rather the unsanitary manner in which the washing was so often done.

Experiments had already indicated that the easiest and fastest method of removing visible dirt from the outside of eggs is by washing. The problem then was to design a machine that would do the washing in a sanitary manner and, at the same time, meet the remaining requirements. After some rather discouraging failures on the first few designs, the present machine was developed which we believe fairly well meets all of the stated requirements.

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1947, as a contribution of the Rural Electric Division.

FORREST B. WRIGHT is professor of agricultural engineering, Cornell University.

This machine thoroughly cleans the entire surface of the eggs without noticeable change in appearance. It is difficult even for a practiced eye to pick out a machine-washed egg from a basket of unwashed, nest-clean eggs.

The eggs are flush-washed in hot water, preferably at 165 F (degrees Fahrenheit) or hotter. The water is supplied through a perforated pipe which extends out over revolving, abrasive-coated cloth disks. The water runs down over the disks which carry the water to the eggs as they are moved along under the disks by moving fingers. The hot water quickly softens and loosens the dirt so that the scouring action of the disks can readily remove it. The water constantly flushing down over the eggs picks up the dirt and carries it to the bottom of the machine and to waste; thus the eggs are flush-washed in a constantly renewed supply of clean, hot water.

The hot water can be supplied from any available source; however, to insure water temperatures of at least 165 F for washing storage eggs, a thermostatically controlled booster water heater attachment is being developed. This attachment will be installed on the feed end of the perforated water pipe.

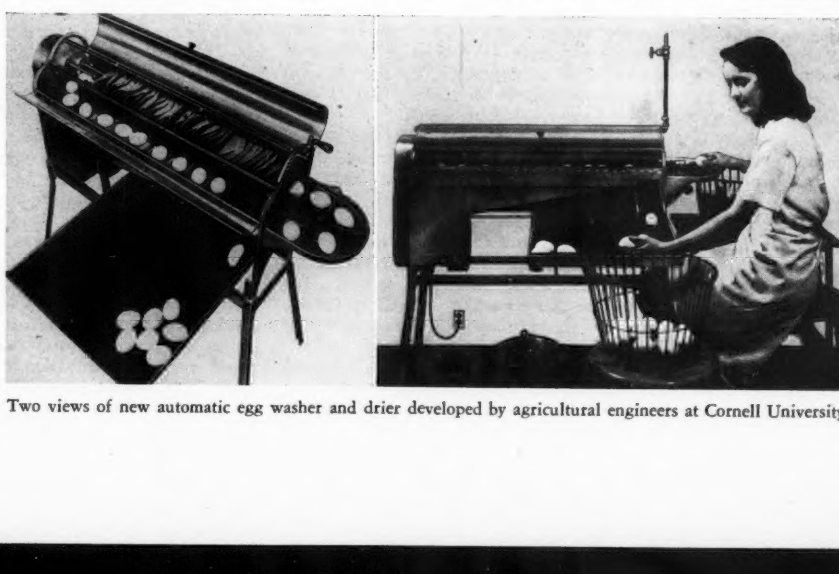
The eggs are held against the pressure of the disks by two plastic rollers. These rollers are necessary for spinning the eggs and to prevent the disks from throwing the eggs out. The spacing of the disks is such that the eggs are caused to turn on their short axis, thus repeatedly throwing the ends of the eggs toward the scouring disks for cleaning.

As the disks have a free radius of approximately two inches, eggs of any size from extra large to peewees can be cleaned without adjustment of the machine.

The combined action of the disks, rollers, and fingers is such that thin-shelled and blind-checked eggs can be cleaned without breakage. In fact, badly cracked eggs can be successfully washed.

After passing through the washer, the eggs are carried by the moving fingers around the end of the machine and into the drier. There they are rolled over toweling which quickly absorbs the free water on the shells. Beyond the toweling, the eggs are exposed to a blast of hot air which finishes the drying process. The toweling is also exposed to the hot air, which prevents saturation.

The eggs are in the hot water for only 22 seconds, which is not time enough for heat to penetrate far into the egg. In candling and the breakout test, no evidence has ever been found of damage to the interior of the eggs. However, enough heat is added to the shell to aid materially in the drying process which follows immediately after washing. By means of thermocouples, we have found that the temperature of the egg shells at the discharge is only 2 degrees above the temper-



Two views of new automatic egg washer and drier developed by agricultural engineers at Cornell University

ature of the same eggs on the feed end. The rapid evaporation of moisture in the drier removes most of the heat picked up in the washer.

By means of a special protein dye, we were able to determine the amount of "bloom" left on an egg after machine washing. There is very little difference between the "bloom" on the nest-clean egg and that on the washed egg.

When loaded to capacity, the machine will clean and dry five cases of eggs per hour, which is at least five times as fast as handcleaning with a buffer. If used in conjunction with another machine developed as an attachment, the eggs are automatically transferred to a grader which makes it possible for two persons to wash, dry, grade, and pack the eggs at the rate of five cases per hour.

Materials and processes used in the manufacture of the machine are relatively inexpensive. When and if the production reaches a large-scale assembly line stage, we fully expect the machine will retail at a price within reach of the small operator. However, as is usually the case with a new product, the price on the first 1000 machines will be somewhat higher.

In preparation for large-scale testing of the keeping quality of machine-washed eggs under actual cold-storage conditions, we have, in cooperation with Dr. G. O. Hall of the Department of Poultry Husbandry and Dr. C. N. Stark of the Department of Bacteriology at Cornell, made some preliminary small-scale laboratory tests. These tests have indicated that the following statements are probably true:

1 Dirty eggs washed in cold water by any known method will not keep as well as unwashed eggs.

2 Dirty eggs washed in this machine with the feed water at a temperature of 165 F, or a few degrees higher, will keep in storage distinctly better than dirty eggs cleaned by any other method tested.

3 The interior quality of eggs is not harmed by exposure in this machine to water at 175 F for 22 seconds.

4 Increasing the temperature of the wash water, at least up to 175 F, hastens the cleaning and drying of the eggs.

It is hoped that this machine, when set up in farmers' egg-processing quarters, connected to a source of hot water, and an electric circuit, will enable farmers to clean eggs conveniently and quickly in a sanitary manner soon after gathering, as they should be, thus making it possible to pack or store the eggs in a more sanitary condition than has heretofore been done.

Patent rights on the machine have been assigned to the Cornell University Research Foundation. A manufacturer has been licensed to build them and they are now on the market.

Opportunities for Agricultural Engineers

(Continued from page 290)

sales organizations 15 years to sell the first 75,000 electric refrigerators. It took 8 years to sell the first 150,000 electric washing machines. Similar experiences apply to everything we have today, whether it is paint, insurance, insulation of buildings, terracing, irrigation, or what not. Any time we are inclined to feel that we have an idea or a piece of equipment which people don't appreciate and for which probably we are foolish to think there is any real need, let's think back to how discouraged our predecessors must have been with every commonly accepted piece of equipment and modern practice that is so generally accepted today. I hope also that we will have greater respect not only for our jobs, but the jobs of men who call themselves salesmen. They are essential to future progress. And let's also recognize that the American public has been sold a falsehood by those who subscribe to the old saying, "If you build a better mouse trap, though you locate your place in the woods, the world will beat a path to your door."

From what I have said, you can see the important role that every one of us, regardless of what his individual job is, plays as an agricultural engineer in making it possible for farm families to further improve farming and living. We also see why such an involved type of society as we have, with the necessary cooperation and exchange of information, produces the results that it does. That is the American way and the way which pays out.

One further point. As agricultural engineers, we carry a responsibility for knowing facts and dealing with facts. The American public is being sold another untruth. That is, that our system of government and our system of competitive free enterprise with incentives for good work should be abandoned because it doesn't work. Now as engineers, we like to deal with facts and figures and I think we should do that in connection with any such statement.

Let me say first that I am the first to admit that our system is not perfect. I call your attention to the fact that our tractors are not perfect, our airplanes are not perfect, even our electric motors and some other things are not perfect, but they are the best we have been able to develop, and, as engineers, we are going to stick with them and improve them and not exchange them for something that is not proved and is not as good. We see that many foreign countries have stayed at about the point they and we were back in the early 1800's. They experience famine regularly, their standards of living are considerably below ours, etc.

Most of us haven't bothered to find out how far we have gotten ahead under our system, but these figures are significant and they are in terms that anyone can understand. The New York Times recently got down to bedrock comparisons of what the Russian and American worker must give in working time to get the same quantities of food and other items. After all, we are working for things we can use. Typical examples are these:

The Russian laborer works 9 times as long as an American workman to buy a pound of veal, 10 times as long for a loaf of bread, 13 times as long for a pound of butter or cotton dress, 15 times as long for a radio, 18 times as long for a quart of milk, 20 times as long for a man's suit, and 27 times as long for a bottle of beer.

Part of the reason is because the productive efficiency of workers in this country is high compared with that of most countries. For example, an American steel worker produces three times as much as a Russian, an American farmer 4½ times as much as a Russian, a U. S. coal miner seven times as much as a Russian. It takes about 60 man-hours to make a radio in this country, 171 man-hours in England, and 262 man-hours in Sweden. A cotton shirt which takes one man-hour in this country takes four man-hours in England, and it took 9½ man-hours in prewar Germany.

The differences in earnings can be explained somewhat by the greater productive efficiency. But because they are still out of proportion, it is suggested that "exploited workers" under a "capitalistic system" get a very good break compared with folks in many of the other countries.

One other point. Each of us is engaged in work of our own choosing. We still enjoy many personal liberties denied to citizens of many other countries. As a matter of fact, you may have noted in a recent editorial in "Ebony", printed by and for colored people, that ninety per cent of the citizens in a long list of foreign countries would gladly change places with Negroes in the United States to enjoy their standards and liberties. As agricultural engineers we should be good citizens; we are looked upon to be leaders in thought, and certainly we should not be backward about free discussion of facts. While attempting to perfect equipment and methods, let's also attempt to continue to improve our system. But let's not exchange it for something poorer.

You and I want to be able to tell our sons that they have just as good a chance as we had to get ahead, that the incentive is there for them to improve themselves while working for the good of everyone; but that what they become is largely up to them. Certainly we can't pass on to them anything more valuable. But we may not be able to safely assure them unless we work and work vigorously to explain, compare, and preserve that system every day.

Tillage in Potato Production

By Watson W. Tranter
MEMBER A.S.A.E.

IN FIELD work, engineers are always concerned with the operation of their machines or the mechanics of the job, and often lose sight of the operation as a whole. I am no exception, and in this instance I found it necessary to consult some of the expert potato growers before I could organize an outline of the operations involved. I have visited many of the potato-growing areas scattered over the United States, and have observed the many different soil management methods and cropping systems employed. In order to draw information from some good examples it is necessary to discount some of these very special potato-growing sections, since their operations in many cases are built around a special kind of soil mining, with little or no attention paid to the over-all effect of their potato production methods.

In many parts of Pennsylvania the climatic and soil conditions are not too well suited to potato production, but on farms that have been under cultivation for a century or more, and in some cases on farms that have been run down and abandoned, we find an unusual number of potato growers producing championship yields. In addition the farm management is such that their land is constantly improved each year, so that it may be handed down to the next generation in better shape, and in a higher state of production than when it was acquired.

These growers really know about tilth, and they can give us the formula for producing that quality of soil. With this thought in mind I interviewed several growers who consistently produced good land and good potato yields, often upwards of 700 bu per acre. One of these men holds the unusual record of 10,000 bu of graded potatoes from a 15-acre plot.

An examination of the cultural methods employed by these growers reveals only the small differences in methods demanded by local conditions. Therefore, to assume average conditions I will discuss the potato-growing operation as carried out quite generally in the central and southern part of the state.

The seasonal changes in this part of the state permit a successful three-year rotation. My description of operations will start with the soil preparation in the fall or spring preceding the potato-growing part of the cycle. It is further assumed that the grower has developed a good cover crop residue for working into this soil. In the first operation this crop residue is thoroughly cut up with disks to start its disintegration and incorporation into the upper soil layer. Whether this is done in the fall or spring depends on the length and severity of the winter in the section in question. Mild winter weather will cause rapid disintegration of this material with some loss of the nitrogen produced. This practice, therefore, varies from north to south, and is an important factor in the soil rebuilding through the use of cover crop residues. The disking is thorough and is done with heavy 21 to 26-in disks, and the surface is left as rough as possible for the absorption of water from snows and rains. If this operation is done in the spring, it is carried out early enough to allow partial disintegration of the cover crop residue before plowing.

The next operation is plowing. This work is started just before planting time, and is maintained just ahead of the planting operation. In the plowing operation, in general, we find two and three-bottom units. The plowing is done 8 to 10 in deep and every effort is made to turn the plow slice on edge.

After plowing the big disks are again employed for a thorough cutting up and mixing of the partially decomposed cover crop residues. Increasing numbers of growers are planting directly on this rough-disked surface. Some, however, add a harrowing operation before planting, providing their land will stand the extra traffic. Modern heavy-duty potato planters operate well on the rough cloddy surface developed in the heavy disking operation, and the land is left in best possible condition for moisture absorption.

Planting is the next operation and determines to a large measure the efficiency in use of seed and fertilizer. Potatoes as a crop require a rather large amount of chemical fertilizer, and we find a wide variation in the amount applied per acre. In some sections applications as low as 300 lb are used, and in others as high as 3,000 lb of plant food material. The usual practice in Pennsylvania is to apply 1,200 to 1,500 lb of 5-10-10 or 4-12-8 or other suitable N-P-K ratio per acre. With this amount of fertilizer, precise fertilizer placement must be employed for efficient production of potatoes, and for best recovery of the fertilizer investment. Experience over a long period has shown that this fertilizer should be placed in two compact bands, one on each side of the seed piece, and approximately 2 in from it, or, in other words, in two bands on 6½ to 7-in centers. These bands also should be one inch or more below the seed piece, depending on the angle of slope of the land.

The next variable in planting is the depth of placement of the seed. In Pennsylvania the most acceptable method is to plant the seed 3 to 4 in below the level of the ground, and to cover very lightly, or, as we describe it, "deep planting-shallow covering." This is logical in the section under discussion, since our planting is usually done well after all danger of freezing has passed. This depth permits wide ridging. Shallow covering permits development of short, vigorous sprouts and permits control of node and internode development by successive pre-emergence cultivations. The spacing of seed in the row is 10 to 12 in, and depends on variety, moisture, soil, and seed size, among other factors. This planting operation consists of fertilizer application and placement, seed spacing, placement, and covering, all in one operation. To permit accurate tractor cultivation, planters are made to plant either two or four rows at a time. Row spacing is another variable depending on soil and moisture, but averages 32 to 34 in.

Cultivation starts a few days after planting to control sprout development and to prevent weed growth. After the first blind cultivation the rows are obliterated and spring-tooth harrows are used for the second, third, or fourth pre-emergence cultivation, when required. After emergence, two-row and four-row cultivators are used. These are carefully adjusted for precise accurate cultivation, and after they are set they are not changed in spacing during the remainder of the season. The purpose of this cultivation is the forcing of a deep root system for the growing plant, the maintenance of a deep, loose water-absorbing furrow between the rows, and hilling and weed control. This work must be done without disturbing the fertilizer bands or the main body of the growing plant. To keep down weeds in the row, short weeder sections are attached to the cultivators, or conventional weeders are used through the third post-emergence cultivation.

All of these operations are designed to produce organic matter in stalks, roots and leaves, and the cash product, potatoes. Maximum production depends on the growth and maintenance of luxuriant, healthy plant foliage. This requires protection from insects and fungi. Therefore, a parallel operation of spraying or dusting is carried out along with the tillage operations.

The harvesting of potatoes is also a tillage operation, since the action of the digger develops a perfect bed for the planting of winter wheat or other cover crop. For best recovery of organic matter, the potato *(Continued on page 296)*

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How to Reduce Ear Corn to Bushels of Shelled Corn

By J. L. Schmidt

FREQUENTLY it is desired to know the number of bushels of shelled corn in a field or crib while the corn is still in ear form. Variety yield tests and fertilizer production trials are examples where ear corn is reduced to and reported as bushels of shelled corn with 15.5 per cent moisture. Another example where ear corn is converted into bushels of shelled corn is that of the commercial hybrid seed corn producers. Here the corn is harvested early at high moistures and delivered in ear form, but paid for as if it were shelled corn with 15.5 per cent moisture. Converting ear corn to shelled corn at 15.5 per cent moisture is a fair practice to follow wherever high-moisture ear corn is sold by weight.

Obtaining the bushels of shelled corn in a field or crib requires estimating the pounds of ear corn per bushel, at any given kernel moisture content. For this discussion, the weight of ear corn in pounds per bushel is defined as the pounds of ear corn required to yield one bushel (56 lb) of shelled corn with 15.5 per cent moisture content. Estimating the pounds per bushel is usually accomplished by converting from the kernel moisture content, using a conversion table or curve. Conversion tables or curves giving the pounds per bushel at different kernel moisture contents have been released by different experiment stations. These tables or curves however, do not all agree. Some tables indicate more pounds per bushel than others at the same kernel moisture content.

To discover the cause of disagreement among the tables and to compute the standard error of estimate when estimating pounds per bushel by conversion from kernel moisture content, the Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, in cooperation with the Iowa Agricultural Experiment Station, analyzed a large amount of data that had been collected over a period of years. The analysis of these data showed that

1 Under some conditions there may be a large error in the use of any single average table or curve for converting kernel moisture content into pounds per bushel for all corn of all seasons.

2 Conversion curves disagreed because of differences in corn due to such causes as variety, season, soil fertility, pollination, and immaturity.

3 These differences among corn are related to difference in shelling percentage. Shelling percentage is defined as 100 times the kernel weight divided by the total ear weight at time of sampling. All ear corn at a given kernel moisture content does not necessarily have the same shelling percentage. Corn with a high shelling percentage requires less pounds on the ear per bushel of shelled corn than corn of the same moisture content with a lower shelling percentage.

4 A multiple relationship exists between kernel moisture content and shelling percentage as corn matures and dries on the stalk.

A Single Average Conversion Curve. When a single conversion curve, representing the average quality of all corn, is used to estimate the pounds per bushel for a field or lot of corn, the estimate is usually biased, depending upon whether or not the curve represents the quality of the corn being estimated. Ordinarily this bias is not large, but it can be at times. A single curve may underestimate or overestimate the true average pounds per bushel of a field. When a single curve was used to estimate the average pounds per bushel for a field in 1940 and 1946, it overestimated the averages by 1.6 and 2.4 per cent, respectively. When this same curve was used to estimate the average pounds per bushel for a late-planted field in 1944 it underestimated the average by 16.9 per cent. If, by chance, the conversion curve represents the quality of the corn being estimated, the bias disappears. The estimate, however, is still subject to the standard error of estimate which is approximately $\pm$ 4.0 per cent for a 30-ear sample of corn.

A Family of Conversion Curves. To eliminate the bias due to differences in corn, different conversion curves are needed for different fields or lots of corn. This requires the use of a series, or family, of curves. Such a family of curves is given in Fig. 1.

This chart was designed to estimate the pounds per bushel from kernel moisture content and shelling percentage. It takes into account that both shelling percentage and kernel moisture content are factors controlling the weight of ear corn required per bushel. This chart faces the fact that corn differs and each lot or field of corn requires a conversion curve of its own.

Use of Chart. Fig. 1 is a calculation chart, if both kernel moisture content and shelling percentage are measured for each sample. Its use is not limited, however, to cases where both shelling percentage and kernel moisture content are determined for each sample. Where more than one sample is taken from a field or lot, only one sample need have both kernel moisture content and shelling percentage determined. The intersection of this sample's shelling percentage and kernel moisture content in the body of the chart will indicate the corn characteristic index line for that field or lot of corn. Once the line is chosen, the kernel moisture content of successive samples can be converted into pounds per bushel along this line.

An example illustrating use of Fig. 1 to estimate average pounds per bushel for a field of corn in the case where three samples are taken, is as follows: The first sample has kernel moisture content of 30 per cent; shelling percentage, 75. Two other samples have kernel moisture contents of 28 and 32 per cent, respectively. The corn characteristic index line for the field of corn is found by following the vertical line of the chart labeled 30 per cent kernel moisture content up to its intersection with shelling percentage curve 75. This intersection is on corn characteristic index line 8. One estimate of pounds per bushel for the field is 90.1 lb, which is read from the diagonal pounds per bushel line that crosses index line 8 at 30 per cent kernel moisture content. Two more estimates for the field are obtained from the other samples by following along line 8 to the intersection of their kernel moisture contents and reading the pounds per bushel at these points—28 per cent moisture, 86.8 lb, and 32 per cent moisture, 93.3 lb. The average of the three sample estimates equal to 90.1 lb is the estimated pounds per bushel average for the field of corn.

Predicting Yield and Computing Water Loss from Artificial Drying. Aside from estimating the pounds per bushel of a field or lot of corn at a specific time (time of sampling) regardless of maturity, as described above, Fig. 1 may be applied to two other cases where pounds per bushel estimates are required. But in these cases the estimates must be restricted to mature corn. Maturity may be defined as that point in growth where the increase in the dry matter of the kernels ceases. It usually occurs around 35 per cent kernel moisture content.

Predicting the yield of a field at some future date, when the corn is drier, is one case where the chart may be used if the corn is mature.

The other case refers to artificial drying where it is necessary to compute the amount of water removed per bushel of corn. This is accomplished by obtaining the difference between the estimated pounds per bushel for the kernel moisture contents before and after drying on the corn characteristic index line applicable to that lot of corn. For the best estimate of pounds per bushel after drying, however, the kernel moisture sample should not be taken immediately. In fast drying, the

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drying rate of the cobs lags behind the drying rate of the kernels, which upsets the normal cob-kernel moisture relationship and, consequently, affects somewhat the pounds per bushel after drying. The effect is not unduly severe, however, since after drying the moisture content is usually low. Nevertheless, most of the effect can be eliminated if the corn is allowed to stand 24 to 48 hours before final sampling, since the cob and kernel moistures tend to equalize to nearly their normal relationship.

The reason for restricting the use of the chart to mature corn when computing water loss and predicting future yields is explained in this manner. The changes in pounds per bushel with kernel moisture content along any corn characteristic index line is based on corn as it matures and dries in the field. Before maturity, pounds per bushel change with kernel moisture content for two reasons, namely, due to the loss of water from the cob and kernels, and due to the increase in dry matter of the kernels. After maturity, however, the increase in kernel dry matter ceases and pounds per bushel changes are due merely to the loss of water from the cob and kernels. Therefore, when the yield of a field is calculated after corn is mature, the yield remains constant and can be applied to a future date when the corn is drier. In the case of water loss by artificial drying, the changes in the estimated pounds per bushel in mature corn before and after drying is due to water removed from the cob and kernels.

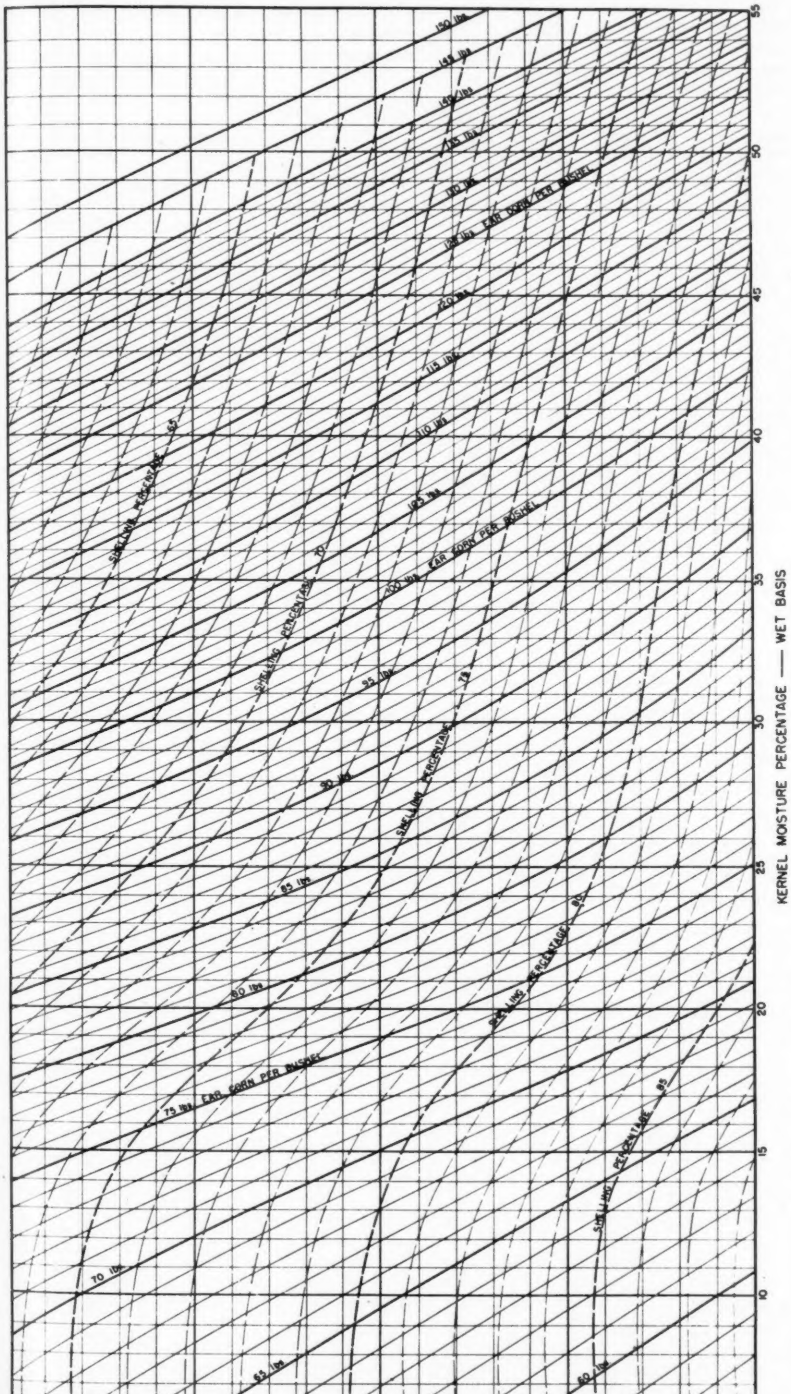

Fig. 1 Weight of wet ear corn required to yield one bushel of shell corn (56 lb at 15½ per cent moisture content)

Standard Error of Estimate. Fig. 1 has a standard error of ±4.0 per cent when estimating the pounds per bushel for a field or lot of corn from shelling percentage and kernel moisture content determined on a single sample of approximately 30 ears of corn. However, this error can be reduced by increasing the number of samples. Table 1 shows the reduction in the error of estimate as the number of samples is increased. The table includes two columns. One column shows the reduction when the shelling percentage and kernel moisture content are determined on every sample, and the other when only the first sample has both shelling percentage and kernel moisture determined with kernel moisture content determined on all others.

Application of Fig. 1 to Good and Poor Quality Corn. Some discussion about where good and poor quality corn falls on Fig 1 seems desirable. Good quality corn, such as that sampled in 1940 and 1946, fell about on corn characteristic index line 4. This corn was well pollinated and the kernels well filled. Poor quality corn from a late field in 1944 fell on line 20. This corn was poorly pollinated and the kernels were chaffy when dry. Ordinary average quality corn falls between lines 5 and 10.

Total Ear Moisture Content

(Per Cent Dry Basis) from Determined Kernel Moisture Content (Per Cent Wet Basis) and Shelling Percentage. In W. V. Hukill's paper, "Basic Principals in Drying Corn and Grain Sorghum", in AGRICULTURAL ENGINEERING for August, 1947 (pp. 335-338), for computing ΔM, it is necessary to have the total moisture content of the ear in per cent dry basis. Total moisture content of the ear depends upon the cob-kernel moisture relationship and the dry cob-dry kernel ratio. Contrary to popular belief, the cob-kernel moisture relationship, as well as the dry cob-dry kernel ratio, is not the same for all corn; therefore, the total ear moisture content is not the same for all corn at any given kernel moisture content. The cob-kernel moisture relationship and the dry cob-dry kernel ratio determined the shelling percentage and consequently the pounds per bushel in Fig. 1. In like manner, the relationship and ratio determines the total ear moisture content shown in Fig. 2. Just as Fig. 1 shows the relationship among shelling percentage and kernel moisture content (per cent wet basis) and pounds per bushel, Fig. 2 shows the relationship among shelling percentage and kernel moisture content (per cent wet basis) and total ear moisture content (per cent dry basis).

TABLE 1. STANDARD ERROR OF ESTIMATE IN PERCENTAGES FOR POUNDS PER BUSHEL ESTIMATED FROM FIG. 1 AS THE NUMBER OF SAMPLES INCREASES

	Standard error of estimate	
No. of samples	Shelling percentage and kernel moisture on all samples, per cent	Shelling percentage and kernel moisture on one sample (all other samples kernel moisture only), per cent
1	±4.0	±4.0
2	±2.7	±3.0
5	±1.8	±2.3
10	±1.2	±2.0
20	±0.9	±1.9

Tillage in Potato Production

(Continued from page 293)

vines and roots are scattered to disintegrate in the soil. They cause little or no trouble if the disk type of drill is used for seeding the winter wheat which is the usual next rotation crop in the area. In the central and southern parts of the state we are fortunate enough to be able to carry out the usual winter wheat program, with clover or rye grass on the fields in the fall. The clover is maintained through the succeeding year, and where the fertility of land warrants, some cropping of this clover is done. With the coming of fall and winter the heavy disking of clover residue is next in order, completing the rotation cycle.

This outline of operations has indicated the use of large and heavy machinery on the land, and growers find that other operations and crops are required to correct the packing effect of this heavy equipment. Many growers now include in their soil management deep-tilling operations to break up the dense layer developed near plowing depth. It is becoming evident that this type of operation must be done. In addition, deep-rooted crops must be grown to reestablish the soil continuity necessary for successful continuous farming. Machines are available for this operation, and others are being developed, which will also place the necessary plant foods, lime, or other soil correctives at lower levels.

It is a satisfying experience to visit the operations of these Pennsylvania potato growers in the fall of the year, to examine their clean potato crops, walk through the thick cover they have produced on the idle fields, and to appraise the tremendous quantity of organic matter that has been developed for working into the soil for the succeeding crops. It is then that we realize these growers are real tillers of the soil. Their management gives them a good cash return for their enterprise, and they steadily add to our greatest national resource, the top soil layer, upon which we depend for food and our economic well-being.

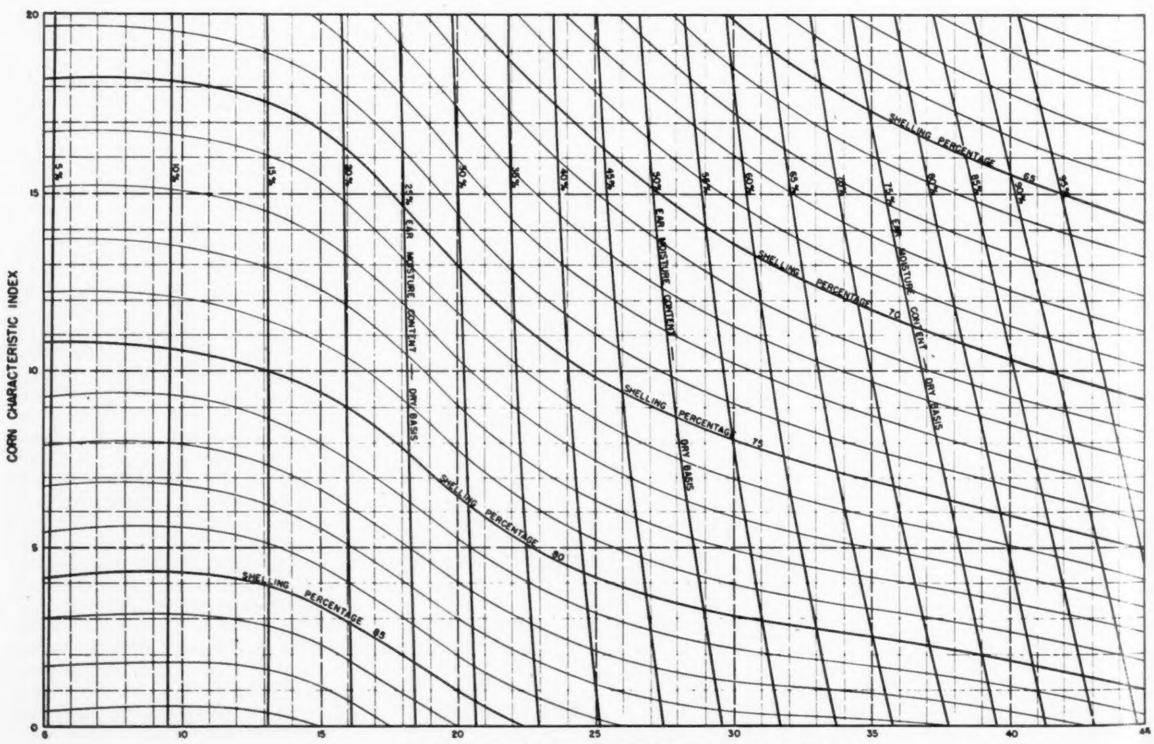

Fig. 2 Total moisture content (per cent dry basis) of ear corn from determined kernel moisture content (per cent wet basis) and shelling percentage

Chinese Agriculture and Its Mechanization

By James Y. T. Yu
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IN COMPARISON with that of the United States, Chinese agriculture is almost entirely different, both in practices and in farming system. The basic difference is in the density of population.[1,2]*

Size of Farming Units. The great density of rural population has produced small farms. The median size for all Chinese farms is 3.31 acres. The wheat region farms (North China), of 3.56 acres, are larger than the rice region farms (Central and South China) of 2.27 acres. The smallest farm areas are in the southeastern rice and rice-tea areas, and are less than 2 acres.[3]

Another factor which makes the very limited area of each farm much worse is its division into several fields which are usually not adjoining each other. On the average, there are 11.6 fields per farm.

The fields average one-half acre in size but are over three times as large for the wheat region as for the rice region. The smallest fields average 0.12 to 0.17 acre for the southwestern rice and rice-tea areas, as compared with 1.26 acres for the spring wheat area between the Gobi desert and the North China Plain.[3]

Efficiency of farming is greatly decreased in such small fields by wasting time in turning at the end of the field and in transporting the implements from one small field to another. A study showed that about 71 per cent more man labor is required to produce rice on farms that have ten or more fields of about one-third acre each than on farms with one to three fields of about one acre[1].

Labor Situation. The greatest source of farm power in China is human labor, and the second greatest is animal power. Mechanical power derived from water, wind, or from internal-combustion engines or electric motors has been used to a very limited extent.

HUMAN LABOR IS FARM POWER IN CHINA

Farm work occupies the full time of a little over two-thirds of the farm population, and constitutes 80 per cent of all work, while subsidiary work is 20 per cent. The equivalent of two men perform farm work and one-half man-equivalent subsidiary work, making a total equivalent of 2.5 men per farm. The availability of subsidiary work is important not only to get supplementary income so farmers can live on such small farms, but also keeps the ample human labor employed. The most important subsidiary occupation is that of home industries, followed by merchandizing[3].

Taking these two figures together, the average farm size and man-equivalent per farm, the man-equivalent per acre of farming land in China appears to be 0.76; 0.70 for North China, and 1.11 for the South.

At the same time, nearly two-thirds of the localities studied by Buck[4] reported insufficient labor at harvesting time, over one-fourth too little labor at planting time, and one-eighth shortage for irrigation. A greater shortage occurred for harvesting, and to a less extent for cultivation in North China where farm areas are larger than those in South China and there is less double cropping.

The amount of man labor required is very much greater than in countries where modern machinery is used and where more animals are driven by one person. Days of man labor per acre required to grow cotton, corn, and winter wheat in China are 53, 23, and 26, in comparison with 14, 2.5, and 1.2, respectively, in the United States[3]. Improvements in implements and machinery for farm operation seems to be the effective method for solving the problem of labor shortage at peak time. The distribution of man labor for all crops is in most places so uneven as to result in periods of either too little or too much work[4].

This extremely uneven distribution of man labor needed gives a paradoxical labor problem on the Chinese farm, that is, to find enough productive work to keep the almost unlimited man labor employed during slack periods, and during the peak period of main farm operations, to reduce the amount of human labor required for each job[3].

Animal Power. By far the greater portion of all animal power available on the Chinese farm is from oxen, water buffaloes, and donkeys[4]. In North China, oxen are used exclusively, and water buffaloes exclusively in the South rice field.

The distribution of animal work on the Chinese farm is much more uneven than for man labor, because of the larger amount of time when there is no work performed. Here, as with man labor, there are periods of time when there is too much work to be done, and at others too little.

Take, for example, plowing for wheat at Anhwei in Central China. There is so much plowing to be done that, if the year is dry, as frequently is the case, much of it cannot be accomplished before it is too dry[4]. More power is needed to get the work done in the proper season.

As one of the inherent disadvantages, animals require feed and care when they don't have any work to do. Enough animals for the peak time work would mean too many animals to take care of in the rest of the year.

Self-Sufficient Mixed Farming. Chinese farming is more self-sufficient than in many other countries. A typical Chinese farmer likes to grow his own rice or wheat and vegetables, and even to wear the cloth woven from his own cotton. Except for cash crops like cotton, tobacco, peanuts, rapeseed, soybeans, etc., they don't want to sell their products, especially their foodstuff. Less than 20 per cent of corn, rice, barley, and millet is sold.

The more diversified the crops, the more subsidiary work will be available on the farm, and consequently the greater difficulty in the application of large implements.

MECHANIZATION OF CHINESE AGRICULTURE

The introduction of mechanical power and modern machinery into Chinese farming was tried several times on the National Reclamation Farms, which had a rather large acreage of land. Yet the results were discouraging, not on the side of machine performance, but from the economic standpoint. Labor on the Chinese farm is ordinarily plentiful and cheap, and capital is scarce, due to the quite limited income from the small area. Petrol fuels depend largely upon importation and are expensive. Feeds for draft animals are usually straw and free pasture, which cost very little. High initial and operating costs have made it difficult for mechanical power with modern machinery, to compete with animal power driving primitive implements.

The total operating cost of tractor plowing per acre in China, as analyzed by Buck[4] early in 1930, was about 2.5 times that of plowing with a water buffalo. The analysis concluded that a tractor, even in regions where fields are large enough, must be able to do enough better work, such as plowing more deeply and more nearly in season, so as to increase the production enough to balance the higher cost per acre, if it is to compete successfully with oxen or water buffaloes. Facts of the succeeding years told us that tractor plowing was a failure.

Buck's analysis of the threshing machine, however, showed that it would thresh as cheaply as the flail and at the same time turn out a clean product. The machine also saved labor

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*Superscript numbers refer to appended references.

at a time when it was needed for other work. Again, his study reported that stationary power had been successfully and increasingly used in the lower Yangtze Valley for irrigation of rice fields. These two favorable results suggested that economy of using mechanical power units can be improved by extending their use around the farm. The increase in the number of days when the machine is in use and the lower initial cost would cut down the unit cost materially. In fact, as indicated in recent correspondence, the situation is now different from that when Buck's study was made. Labor has become more and more expensive because of the high price of food. The supply of domestic petrol products has been continuously increased. However, an up-to-date study is needed to reach any definite conclusion.

Adoption of More Suitable Tractors and Implements. Even worse than the situation in Europe, the dense population, extremely small fields and diverse variety of crops raised on farms in China have hindered the use of mechanical power and farm machinery. One way to improve the situation is to enlarge the farm area through cooperation or any other type of collective farms. A larger farm has not only the land adequate for such machines, but also enough capital to invest in them. For such large units, tractors and implements have been already quite well developed in other mechanized countries. The problem would merely be modification and adaptation of those machines. Yet the farmers are more or less conservative. This change of agricultural system cannot be easily made. It may take quite a while before the farmers are ready for the successful introduction of big machines.

In addition to the reorganization of small farms to suit the use of big machines, the tractor power unit and machines will have to be modified as far as possible to a small but still advantageous unit to suit the tiny fields. Above all, an adequate power unit should first be developed to meet the requirements of the small farming area. Then a set of implements can be designed accordingly.

As stated before, the extremely uneven distribution of farm work has caused problems of both shortage of labor at peak time and of work for the laborers in the slack seasons. Readjustment of the cropping system may help to a certain extent. But from the agricultural engineering standpoint, the release of farm labor at peak period may depend on more efficient machines; and to provide employment for farmers in the slack season, rural industry should be developed.

Development of Rural Industry. In addition to creating employment for farmers in the slack seasons, rural industry has a threefold effect in promoting Chinese agricultural mechanization. Processing or semimanufacturing will improve the quality and marketability of farm products; and higher prices for them may be expected. Whether the farmers own these plants or not, their income would proportionally be increased. It would then be easier for them to invest money in implements to reduce the drudgery of farming.

RURAL INDUSTRY WILL REQUIRE LARGE AMOUNTS OF LABOR FROM NEARBY RURAL AREAS

Rural industry needs a good amount of labor which will naturally be recruited from the nearby rural areas. After such industry gets so developed that the half-time workers released from farming during slack seasons won't be enough, there will be inevitably a decrease in the number of laborers being engaged in farming. Having not enough hands around, farmers will have to look for more labor-saving farm implements.

As another result of lack of farm laborers, the very small units will tend to unite into bigger farms, which would make the adoption of mechanical farming more feasible.

Rural industry has a very wide field and can be operated at any size. To begin with, it may be established on a rather small scale, and be owned by an individual or a group of farmers or by means of co-operatives. Even a well-organized hand-craft factory can easily prove to be very profitable, not only to the individual workers but also to the community.

An endless list can be made for the probable items in the field of rural industry. They may do handcrafting, grain cleaning, grading, or processing, meat processing, fruit canning and dehydration, sweet potato dehydration, vegetable oil pressing, fiber crop processing, low-grade paper manufacturing, sugar refining, small-scale cigarette or cigar making, rug weaving, straw hat manufacturing, or anything else depending upon where they are located and how well they are equipped. As a matter of fact, many of the mentioned items have been the Chinese farmer's subsidiary work for extra income. They are, however, more or less family operated and very poor in their equipment and organization. Much more efficient industrial co-operatives have been organized lately both in suburbs and in rural areas. They seem quite successful and hopeful.

China is planning for her postwar industrialization. Rural industry is only a part of the whole project. Only on adequate transportation and necessary manufacturing can industries build the foundation of rural industry, as well as for agricultural mechanization.

SUGGESTED ESSENTIALS OF A TRACTOR FOR CHINESE FARMING

The mechanization of Chinese agriculture is not an easy-to-solve problem. The solution can only be obtained by approach from various angles and by the efforts and cooperation of people in all different fields. From the standpoint of an agricultural engineer and based on the foregoing reasoning and analysis of Chinese agriculture, the following essentials of a small tractor are suggested. Such a small tractor is believed to have its importance in mechanizing Chinese small farms, as well as in serving as a primary step while small farms are being reorganized into larger units.

Enough Power to Pull a Plow of 10 to 12 Inches. The Chinese conventional-type plow for oxen or buffaloes turns a furrow slice approximately 6 in wide and 5 in deep. Two bottoms of this type of plow have draft equivalent of a 10 to 12-in moldboard plow.

For heavy clay soil, which is usual in South China, the draft of plow per square inch of furrow section is 7 to 10 lb, according to Davidson[5]. Plowing at 2 mph, the power of the tractor to pull a plow of 12 in needs to be 2.24 to 3.2 dhp. Supposing the transmission efficiency from engine to drawbar to be 50 per cent, the engine for such a tractor would need a rating of 4.5 to 6.4 hp.

For clay loam, which resembles loess in North China, the draft of plow per square inch of furrow section is about 7 lb, which, following the same calculation, would take an engine of 4.5 hp rating. A tractor thus powered will be able to plow at least twice as fast as an ox or buffalo. Besides, a much better job can be obtained in plowing due to the increased width of the plow.

Ability to Handle Light Work Like Seeding and Cultivating. Seeding of some crops, like cotton, has to be done within a short period of time when soil and climatic conditions are most favorable. Cultivation after each rain is another rush job to preserve the soil moisture. Neither of these operations needs as much power as plowing, but the tractor chassis should be so arranged that such implements can easily be attached and guided while in operation.

Since various crops are raised on one farm, the easily adjustable tread for different widths between rows becomes very desirable. For late cultivation, high clearance of chassis would be another practical feature.

Convertibility to Trailer. Transportation has been one of the important reasons why Chinese agricultural production needs a large amount of labor. Although animal-drawn wagons are used in many places, a lot of transportation, especially from field to farm house and to nearby market, has been done by human effort. Supposing small farmers are persuaded to buy tractor units, they undoubtedly will not be able to invest more money in modern transportation facilities. A tractor which is convertible to a transport unit may meet this need. A wood box can always be made by local carpenters at nominal cost. With some convenient devices, a farmer can easily change his tractor to a hauling unit. *(Continued on page 300)*

Reconditioning Overdried Hay

By Charles E. Ball and E. L. Barger
Junior Member A.S.A.E. MEMBER A.S.A.E.

THE equilibrium moisture content of barn-dried alfalfa hay is about 17 per cent when the relative humidity is 80 per cent[1]. An increase in relative humidity from 63 to 93 per cent caused the moisture content of dried grass meal to rise from 10.5 to 22.5 per cent in 24 hr[2]. Thus it seems logical that by blowing high-humidity air through hay as dry as 10 per cent moisture, one should add moisture and recondition the hay.

Why Recondition Hay. The first attempt to recondition hay at Iowa State College was in November, 1946, when a batch of mow-cured hay was to be moved. Attempts to bale it were unsuccessful because the dry brittle hay, of 10 to 11 per cent moisture content, would break rather than feed into the bale. Reconditioning would have been desirable, but operation of the fan during periods of high humidity did not add any appreciable moisture to the hay.

In August, 1947, dried chopped alfalfa was being blown into a barn mow and shattering of leaves was excessive because the hay was too dry. Again reconditioning would have been desirable.

Some farmers believe chopped hay makes their cows' mouths sore because of the dry condition and short lengths of stems. By adding moisture, it might be possible to make the hay more palatable for the cow and alleviate the farmer's prejudices against chopped hay.

Reconditioning During Rainy Season. In October, 1947, an attempt was made to recondition dried hay by operating the drying unit during a rainy period. The rain lasted four days and the fan ran continuously during this period. The outside dry-bulb temperature averaged 55 F and the relative humidity 90 per cent. However, when the air was brought inside through the fan, the temperature was 60 F and the relative humidity 75 per cent. This slight temperature rise and relative humidity drop could be expected when outside air is brought into any building. After four days operation the moisture content of the bottom layer was raised from 12 per cent to 17 per cent, while at the middle and top the moisture content remained unchanged. The depth of stored hay was 7½ ft.

Small-Scale Drying Unit. The investigation was continued with a small-scale drier built inside the laboratory where practically all the variables could be controlled. The apparatus used is illustrated in Figs. 1 and 4. The plenum chamber and bin of hay were set on scales that would weigh to 0.01 lb. The bin, which was made of 14-in sheet metal pipe, was insulated so the room temperature would have practically no effect on the process inside. The air was passed through a humidifier with heaters and sprays so that air of any desired temperature and relative humidity could be obtained. Hay to a depth of 4 ft was placed in the bin for each test, and about 19 cfm of air per square foot of floor space was supplied.

Results. The results of eight tests are summarized in Table 1. They varied in length from about 1½ days to about 10 days. The relative humidity of entering air varied from 73 to 94 per cent. All moisture contents were determined with an electric oven except the final average. It was calculated by using the original average per cent moisture and the increase in weight.

In run 1 it may be noted that, in 35 hr, air entering at 94 per cent relative humidity caused the average moisture to rise from 11.5 to 17.9 per cent. However, the unequal mois-

TABLE 1. RESULTS OF EIGHT TESTS ON RECONDITIONING CHOPPED ALFALFA HAY

Run No.	Length of run, hr	Original sp. wt., lb/cu ft	cfm per sq ft	Air Entering Temp., F*	Air Entering %RH	Air Leaving Temp., F*	Air Leaving %RH	Moisture content of hay, per cent wet basis: Original average	Final average	Bottom†	Center	Top
1	35	7.67	19.3	61	94	64	70	11.5	17.9	23.5	16.0	15.4
2	47	7.65	16.5	62	89	65	71	13.5	19.5	25.6	15.4	13.8
3	65	6.60	18.8	63	82	66	68	12.7	15.5	20.3	16.1	13.4
4	86	6.34	19.8	76	86	—	—	12.7	18.0	19.0	17.8	15.8
5	89	6.98	19.8	54	84	56	70	13.0	16.5	17.3	17.0	16.0
6	92	7.17	18.1	60	73	62	68	13.1	13.5	14.7	13.7	14.3
7	160	7.18	16.5	63	87	66	75	13.1	22.0	24.3	20.4	16.8
8	234	8.15	19.3	59	74	62	69	13.6	16.4	16.0	14.5	14.9

*Temperatures in degrees Fahrenheit, dry bulb. †Average of bottom 6 in.

This paper was presented at the winter meeting of the American Society of Agricultural Engineers, Chicago, December, 1947, as a contribution of the Farm Structures and Rural Electric Divisions. Authorized for publication as Journal Paper No. J-1550 of the Iowa Agricultural Experiment Station, Project No. 922.

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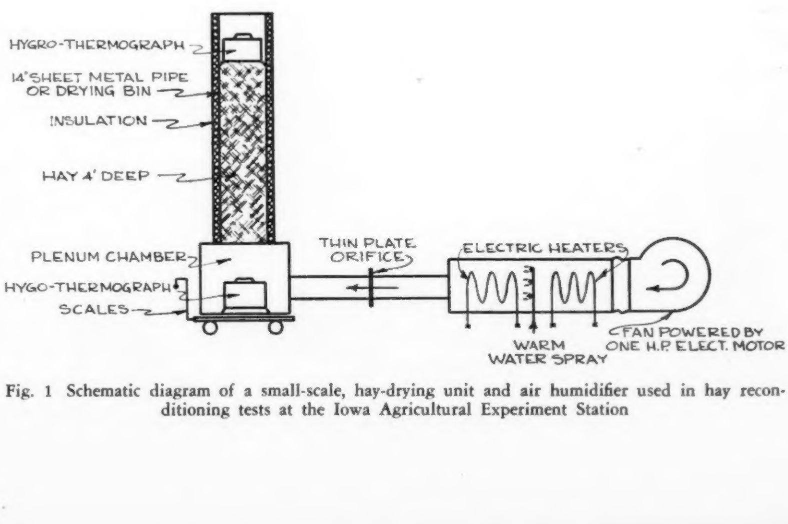
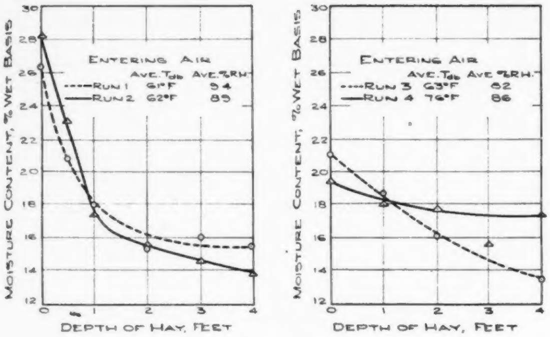


Fig. 1 Schematic diagram of a small-scale, hay-drying unit and air humidifier used in hay reconditioning tests at the Iowa Agricultural Experiment Station



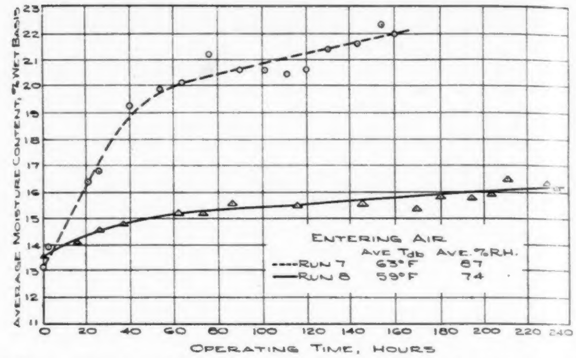


Fig. 2 (*Left*) Curves showing moisture distribution in hay at end of Runs 1, 2, 3, and 4 • Fig. 3 (*Right*) Curves showing rate of increase in moisture content for Runs 7 and 8

ture distribution illustrated in Fig. 2 shows that a critical situation existed. The very bottom was 26.2 per cent moisture, the middle 16 per cent and the top only 15.4 per cent. Of course, had it been allowed to sit for any length of time the bottom would have spoiled. Thus, for reconditioning it would appear that air with a lower relative humidity must be used, and the length of running time must be increased.

In run 8, air entered at 74 per cent relative humidity for 234 hr and raised the average moisture content from 13.6 to 16.4 per cent. The difference in top and bottom was only 1.1 per cent, so uniform distribution was approached. However, had the moisture reached equilibrium throughout the hay, and had the increase been as great as desired, the cost of this prolonged operation would probably outweigh the benefits gained. The only practical means of reconditioning that is feasible is to run the fan during rainy periods when the humidity is high. The likelihood of getting these high humidities for any one period and at the time needed is about nil.

Fig. 3 shows the rate of moisture increase for runs 7 and 8. These curves are quite typical of all the tests in that the slope (rate of increase) was quite steep at first, particularly for the high relative humidities, and then begin to flatten out.

SUMMARY

1 Reconditioning of overdried hay is desirable if it is to be moved after drying. It would be easier to handle and many leaves would be saved. Also, the palatability would be increased.

2 Tests where relatively high humidities were maintained show that hay absorbs moisture quite rapidly during the first few days. Then during the remaining days, when equilibrium in the lower layers is approached, the rate of absorption is slow.

3 The bottom layer of dry hay absorbs most of the moisture, leaving very little for the upper layers. Thus, with relative humidities above 85 per cent, the bottom begins to spoil before any appreciable change takes place in the top.

4 The hygroscopic characteristics of hay make reconditioning appear to be impractical.

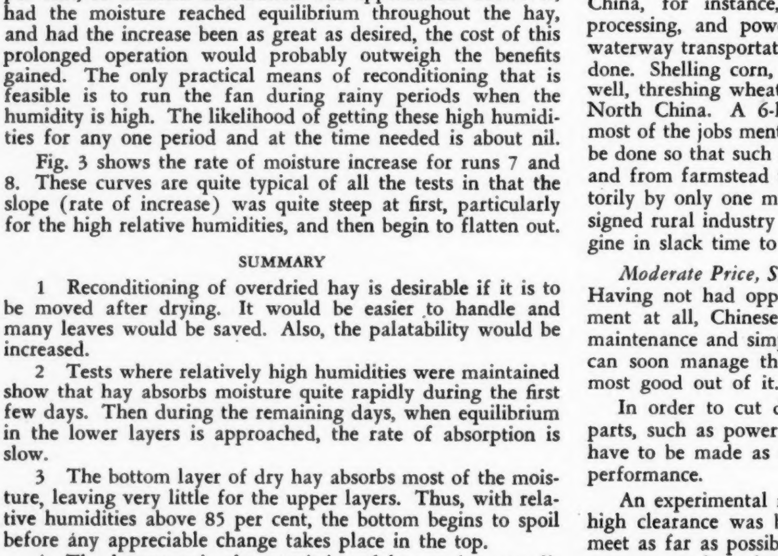


Fig. 4 The experimental unit used in the Iowa hay reconditioning tests

Chinese Farm Mechanization

(Continued from page 298)

Owing to the rather bad conditions of the country roads, the speed of transport units may be limited to 10 or 15 mph. In comparison with the wheelbarrow or donkey with speed of about 3 to 4 mph, 10 mph will be fast enough.

Provisions Made for Stationary Work. Stationary power is needed on farms for almost infinite purposes. A tractor for small farmers should be able to do the job for them. In South China, for instance, pumping water, threshing rice, rice processing, and powering a junk or boat for the frequent waterway transportation are some of the important jobs to be done. Shelling corn, grinding feed, pumping water from the well, threshing wheat and soybeans are work which exists in North China. A 6-hp engine needed for plowing will do most of the jobs mentioned. Some redesign work may have to be done so that such a series of work from field to farmstead, and from farmstead to market, can be accomplished satisfactorily by only one moderately priced tractor. A properly designed rural industry of small scale may employ the same engine in slack time to extend the use of the tractor.

Moderate Price, Simple Maintenance, and Easy Operation. Having not had opportunity of learning service and adjustment at all, Chinese farmers will need easy and foolproof maintenance and simple operation of the tractor, so that they can soon manage their new mechanical power and get the most good out of it.

In order to cut down the price of such a machine, the parts, such as power transmission, steering, brakes, etc., will have to be made as simple as possible, yet with satisfactory performance.

An experimental machine of single front-wheel drive and high clearance was built in 1947 at Iowa State College, to meet as far as possible the foregoing requirements. Both appearance and performance of this machine were quite encouraging. Further studies will have to be made in order to approach perfect satisfaction.

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Results of Irrigation Research in Georgia — Part II

By John R. Carreker and W. J. Liddell
MEMBER A.S.A.E. MEMBER A.S.A.E.

A RESEARCH project of supplemental irrigation was begun in 1946 by the University of Georgia agricultural engineering department in cooperation with the research division of the Soil Conservation Service, U. S. Department of Agriculture. An over-all description of the project and results of climatological, ground water, and nozzle discharge studies were given in Part I in AGRICULTURAL ENGINEERING for June, 1948.

Research results obtained in 1946 and 1947 with supplemental irrigation on pastures, vegetables, and corn are given in this article.

The 1946 studies with vegetables included lima beans, okra, squash, cucumbers, green peppers, tomatoes, onions, snapbeans, and beets. The yields of the last four named were affected by outside influences such as nematode infestation, diseases, insects, and poor germination of seeds so that the irrigation effects were not ascertained.

The effects of irrigation versus none on the check plots are shown in the yields per acre given in Table 3. Substantial yield increases were obtained from irrigation with the lima beans, okra, squash (early), cucumbers, and green pepper.

Ten irrigations were made, varying from one-half to one inch at a time, in accordance with previous rainfall. The amount applied was adjusted so that the vegetables received at least one inch of water each week. These ten applications were made as follows: One in June, three in July, four in August, and two in September.

The 1946 corn studies included 14 varieties planted in rows 42 in apart with hill spacings of 12, 18, and 24 in. The corn was planted a month later than normal, and in most seasons would have responded to irrigation. In 1946 the rainfall pattern was nearly ideal for corn production. The first irrigation of 2 in on July 30 was followed that night by a rain of 2¼ in, and the second irrigation of 2 in on August 13 preceded a 1.9-in rain by only seven days.

Therefore, no significant differences in yields were measured with and without irrigation. The spacing between hills did give significant differences, however. The irrigated corn yielded 61.4, 54.9, and 47.1 bu per acre for the 12, 18, and 24-in spacings, respectively. Likewise the unirrigated corn yielded 55.0, 49.6, and 42.3 bu per acre for the 12, 18, and 24-in spacings. These yields are the average for all 14 varieties planted on each plot and also are the average of four replications.

A 4-acre pasture was planted in 1946 to ladino clover, dallis grass, and kobe lespedeza. Much Johnson, crab, and other native grasses grew along with those planted. The entire 4 acres was irrigated once in 1946 with a 2-in application. In order to permit the vegetation to become well established, the pasture was not grazed during the first season. Three mower clippings helped to retard weed growth.

In 1947 this pasture was divided into four one-acre blocks with two blocks irrigated and two unirrigated. The number of animals on each two acres was adjusted to the respective carrying capacity of the pasture.

The dates and amounts of rainfall and irrigation on the pasture, vegetables, and corn for the period April 1 to Septem-

This is the second part of a combination of two papers presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1947, and at a meeting of the Southeast Section of the A.S.A.E. at Washington, D. C., February, 1948.

JOHN R. CARREKER and W. J. LIDDELL are agricultural engineers employed cooperatively by the Soil Conservation Service (Research), U. S. Department of Agriculture, and the agricultural engineering department, University of Georgia, Athens.

AUTHORS' ACKNOWLEDGMENT: Nematode control studies were cooperative with Dr. J. H. Miller, plant pathology dept., University of Georgia.

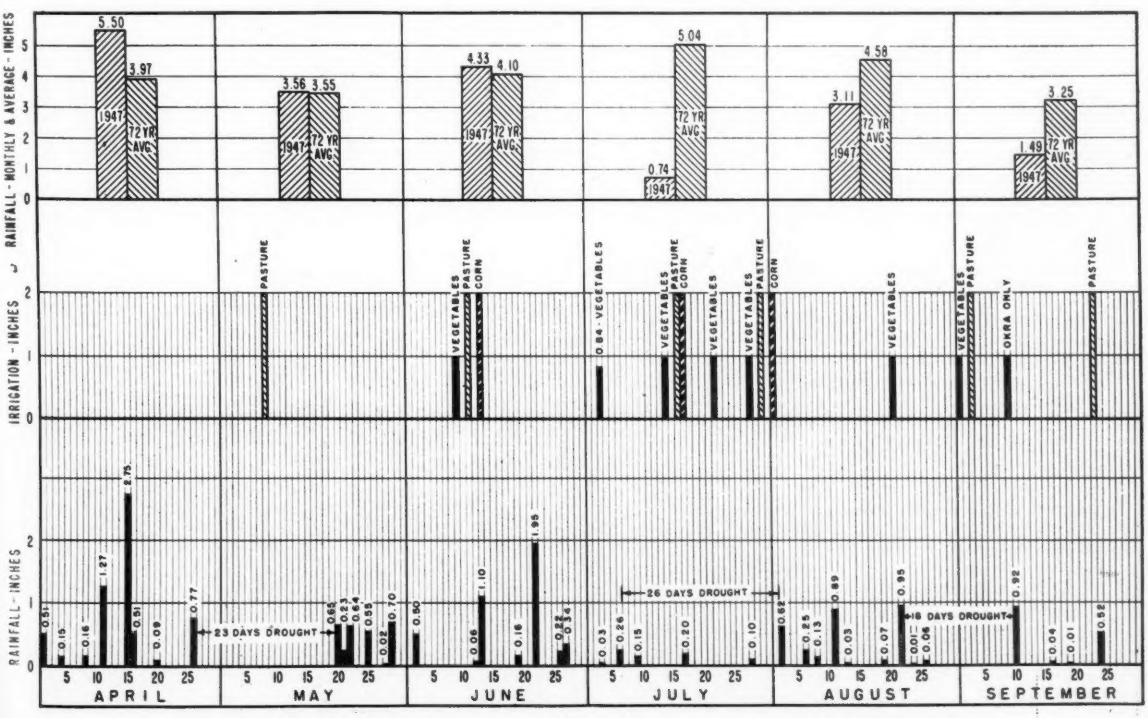


Fig. 6 Rainfall and irrigation on pasture, vegetable, and corn plots during growing season, 1947

TABLE 3 - YIELD OF VEGETABLES WITH AND WITHOUT IRRIGATION IN 1946 AT ATHENS, GEORGIA

CROP	CROP YIELD			
	IRRIGATED	UNIRRIGATED	INCREASE	
	LBS/ACRE	LBS/ACRE	LBS/ACRE	PER CENT
Lima Beans	7,437	4,771	2,666	55.9
Okra	11,042	6,906	4,136	59.9
Squash (early)	8,431	7,534	897	11.9
Cucumbers	15,966	10,121	5,845	57.8
Pepper, Green	20,908	9,505	11,403	120.0

TABLE 4 - YIELD OF TOMATOES WITH AND WITHOUT NEMATODE CONTROL IRRIGATED AND UNIRRIGATED

FUMIGANT	CROP YIELD			
	IRRIGATED	UNIRRIGATED	INCREASE	
	LBS/ACRE	LBS/ACRE	LBS/ACRE	PER CENT
Shell D-D	44,811	38,485	6,326	16.4
Dow D-D	47,963	38,598	9,365	24.2
Dow W-40	45,740	29,120	16,620	57.2
Untreated (Check)	28,014	27,268	746	2.7

ber 30 are shown in Fig. 6. There was no irrigation before or after this period in 1947.

The irrigated two acres of pasture received six 2-in applications, these being on May 8-9, June 10-11, July 15-16, July 29-30, September 2-3, and September 29-30. The June 10-11 irrigation was followed by 1.10 in of rain on June 13. The other applications had time to be effective before rains occurred.

The irrigated and unirrigated pastures of two acres each were stocked with dairy heifers approximately one-year-old May 5, 1947. Through September 15, 1947, the records showed:

	Irrigated	Unirrigated
Animal days of grazing, per acre*	558	264
Animal gain in weight, lb per acre	580	350
Vegetative growth (air dry), tons per acre	3.40	2.35

The vegetable studies in 1947 included tomatoes, okra, and pole beans with and without irrigation. Superimposed on these was a comparison of three brands of soil fumigant versus none for nematode control.

These fumigants were:

(1) D-D**, manufactured by Shell Chemical Corp.

(2) D-D**, manufactured by Dow Chemical Corp.

(3) Dowfume W-40***, manufactured by Dow Chemical Corp.

The average yields of tomatoes for the four nematode control treatments, with and without irrigation, are given in Table 4. Without irrigation and without nematode control, the yield was 27,268 lb per acre. Irrigation without the nematode control increased this yield only 746 lb per acre, or 2.7 per cent.

Without irrigation, the W-40 increased the yield from 27,268 to 29,120 lb per acre, or 6.8 per cent, while the Shell D-D and the Dow D-D gave yields up to 38,485 and 38,598 lb per acre, respectively, or about 41 per cent greater.

The combination of irrigation and nematode control gave yield responses up to 47,963 lb per acre, or about 65 per cent greater than the yields from irrigated plots without the soil fumigant treatment.

The yields of okra in 1947 with and without nematode control, irrigated and unirrigated, are given in Table 5. The unirrigated, untreated plots gave a per acre yield of 5129 lb. Without irrigation but with nematode control, the yields were 5993, 6611, and 7748 lb respectively, for Dow W-40, Shell D-D, and Dow D-D. These yields represent increases of 864, 1482, and 2619 lb per acre, or 17, 29, and 51 per cent, respectively.

The okra yield with irrigation but without nematode control was 7781 lb per acre, 2652 lb per acre (or 51.7 per cent) greater than the 5129 lb without the nematode treatment and without irrigation. Irrigation and nematode control gave yields of 9188, 10,371, and 10,503 lb per acre, respectively, with the Dow W-40, Shell D-D, and Dow D-D. These yields represent gains of 1407, 2590, and 2722 lb per acre, or 18, 33, and 35 per cent, over the irrigated check. Irrigation increased the yield about the same percentage with or without the nematode control.

There was no significant effect on yield of pole beans with the use of the soil fumigants. The irrigated beans yielded 5,864 lb per acre, with 94 per cent of excellent quality; while the unirrigated beans yielded 3,385 lb per acre, with only 73 per cent of excellent quality. This increase of 2,479 lb, or 73.2 per cent, in yield was apparently due almost entirely to irrigation.

The corn study in 1947 included the three hill spacings of 12, 18, and 24 in, with rows 42 in apart, repeated from 1946. Four rates of fertilizer application were superimposed on these three hill spacing variations.

Three irrigations were given to the corn in 1947. Applications of two inches each were made June 12, July 16, and August 1. The June 12 application was followed by 1.10 in and that on August by 0.62 in of rain. No rain fell between the July 16 and the August 2 irrigations.

The corn yields for the respective hill spacings and fertilizer rates are given in Table 6. (Continued on page 304)

* The animal-grazing unit is based on dairy heifers averaging approximately 400 lb in weight. It is not corrected to 1000-lb cow units.

** Dichloropropane — dichloropropylene

*** Ethylene — dibromide

TABLE 5 - YIELD OF OKRA IN 1947 WITH AND WITHOUT NEMATODE CONTROL IRRIGATED AND UNIRRIGATED

FUMIGANT	CROP YIELD			
	IRRIGATED	UNIRRIGATED	INCREASE	
	LBS/ACRE	LBS/ACRE	LBS/ACRE	PER CENT
Shell D-D	10,371	6,611	3,760	56.8
Dow D-D	10,503	7,748	2,755	35.6
Dow W-10	9,188	5,993	3,195	53.4
Check	7,781	5,129	2,652	51.7

TABLE 6 - 1947 CORN YIELDS** BY IRRIGATION, FERTILIZATION AND SPACING TREATMENTS

FERTILIZER RATE*	IRRIGATED			UNIRRIGATED		
	HILL SPACINGS IN ROW			HILL SPACINGS IN ROW		
	12"	18"	24"	12"	18"	24"
	BUSHELS/ACRE			BUSHELS/ACRE		
A	84.7	76.7	66.1	76.4	56.5	55.3
B	112.8	92.8	83.6	80.9	63.7	62.4
C	124.J	95.1	79.5	82.3	70.1	68.5
D	116.6	100.3	82.8	79.8	73.3	65.9
A, B, C AND D AVERAGE	109.5	91.2	78.0	79.8	65.9	63.0

* EXPLANATION OF FERTILIZER RATES:

RATE	AT PLANTING IN ROW 4-10-6	SIDE DRESSING FIRST CULT. 4-10-6	SIDE DRESSING SECOND CULT. N. OF SODA	TOTAL APPLICATION $N - P_2O_5 - K_2O$
	POUNDS/ACRE			
A	500	0	0	20-50-30
B	500	0	250	60-50-30
C	500	0	500	100-50-30
D	500	500	500	120-100-60

108 lbs./ac. P_2O_5 + 60 lbs./ac. K_2O broadcast on all plots before planting

** On basis of 100% stand. Samples taken from all plants not adjacent to skips. All plots planted to Tennessee 10 hybrid.

Results of Low-Cost Concrete Flumes

By C. A. Kincaid
MEMBER A.S.A.E.

IN 1934, J. C. Wooley, head of the agricultural engineering department, University of Missouri, conceived the idea that a structure could be built of concrete, without using forms, to lower water from one elevation to another. He named this structure the "thin-section concrete flume."

The first of these flumes was built in 1934 on one of the University's experimental farms near Columbia, to observe its performance. The concrete, 2 in thick, was plastered to the earth. It was shaped to form an inclined trough to permit the water to drop from a terrace into a road ditch. The design of the flume was such that the concrete did not support any vertical walls of earth, but served to protect the soil from the weather and let the water flow down the face of the flume. Even though it developed cracks, this thin section of concrete served its purpose for several years.

In 1936 this structure was introduced in the Missouri soil conservation program by the Extension Service. Several were built in various counties during the following years, on a demonstration basis, in cooperation with a Portland Cement Association fieldman.

In 1940 it was evident there was a definite need for and an interest in some type of structure that would be lower in cost than the drop spillway (or weir notch) dam, to solve many of the gully erosion problems confronting farmers and soil conservation technicians in Illinois.

After the flume-type dam was discussed with extension engineers and soil conservation technicians it was agreed to try a few structures to see what results could be obtained. Two logical spots for locating flumes were chosen by the U. S. Soil Conservation Service, and demonstration flumes were built in August, 1941—one in Montgomery County and the other in Adams County. Since that time 29 additional demonstration structures have been built in soil conservation districts or counties under the sponsorship of district technicians and farm advisers.

Design of the Structure. The design of the concrete flume is such that the concrete slab does not support any vertical wall of earth. Advantage is taken of the angle of repose of the soil. The toe wall across the lower end of the flume always extends downward a minimum of 18 in, in order to reach a stable soil in the waterway under the structure. Where stability at this minimum depth is questionable the toe wall is extended downward far enough to insure against the structure being undermined. The upper toe wall or cutoff wall is always extended downward at least 30 in below the crest of the notch and is carried the full length of the notch opening and both wing walls. The rollback on the sidewalls is curved over so the top width measured from the face of the sidewall is at least 12 in. When these cutoff sections are completed properly, there is little possibility for water to get underneath the concrete to undermine the structure or saturate the soil. This condition, if allowed, might result in heaving in freezing weather.

Construction. The slope on the face of the flume should be about two to one in order that the sidewall slopes will conform to the recommended side slopes on the berms joining the wing walls. The slopes on the sidewall face can be about one to one. When woven wire is used as reinforcement no difficulty will be experienced in placing the concrete on these slopes. The usual procedure followed has been to place a layer of concrete $2\frac{1}{2}$ in thick over one sidewall, raising the woven wire through the concrete. This is followed with another layer of concrete $2\frac{1}{2}$ in thick before initial set takes place in the first layer. A third layer 1 in thick is placed and finished with a wood float and steel trowel. This operation is then repeated on a strip about 2 ft wide adjacent to the completed sidewall. Then other strips are placed and the process continued across the flume. Before placing the last 2-ft strip, the remaining sidewall is placed. The remaining 2 ft on the face of the flume is placed and finished, working down the slope toward the apron. This results in a full 6-in thickness of concrete over the entire structure.

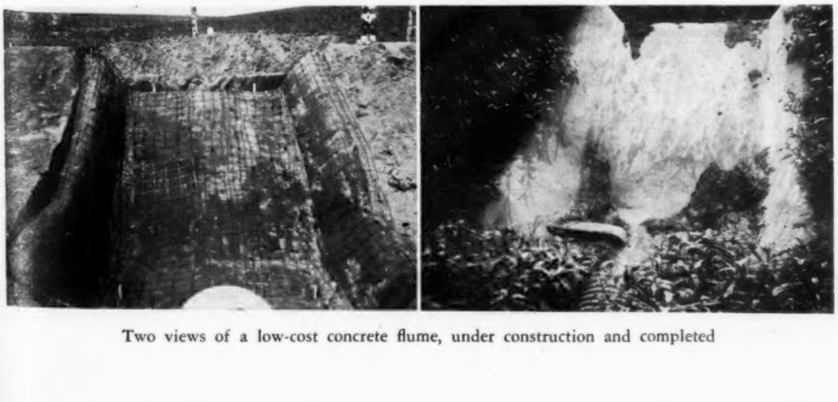
The upper cutoff wall has been changed from an inclined slope, as used in the earlier flumes, to a vertical trench to eliminate the labor of excavating a trench wide enough to work in.

Good quality concrete usually results because a lower water-cement ratio than is generally used in farm produced concrete is required to make the mix stiff enough to stay on the slopes. A mixture of good workability is 1 part portland cement, $2\frac{1}{4}$ parts of a good concrete sand graded from $\frac{1}{4}$-in size particles down to particles of which 5 per cent will pass the 1/100-in mesh screen, and 3 parts gravel graded from 1-in down to $\frac{3}{8}$-in particles. Use about $4\frac{1}{2}$ gal of mixing water per sack of cement if the sand is of average moisture content. If the sand is dry, use $5\frac{1}{2}$ gal and if very wet, use 4 gal. Average moist sand will contain about $\frac{1}{2}$ gal of water per cubic foot. Thus a little over 1 gal of water is already in the sand, plus $4\frac{1}{2}$ gal mixing water added, makes a $5\frac{1}{2}$ gal paste. This produces a high-quality concrete if clean sand and gravel are used and the concrete is kept moist for at least 7 days to cure.

The reinforcing steel used in most of the demonstration structures was regular woven wire as heavy as was available, preferably all No. 9 wires. A few were built using $\frac{3}{8}$-in reinforcing steel rods placed 12 in on centers both ways.

The woven wire is easy to put in place and shape to the contour of the earth and facilitates the placing and holding of the concrete mix. The entire excavated surface is covered with the wire, which is securely tied together at all laps, before any concrete is placed. In all structures built since 1943 at least one $\frac{1}{2}$-in reinforcing rod has been placed in the top of the roll over along the sidewalls, extending the full length of the wing walls through the side-apron walls. On structures with notch depths of 3 ft or more, two $\frac{1}{2}$-in rods are used, the second rod being placed about half way up from the face of the flume in the sidewall.

Farmers have demonstrated their ability to build these structures. One man 75 years of age, after witnessing a demonstra-



Two views of a low-cost concrete flume, under construction and completed

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1947, as a contribution of the Soil and Water Division.

C. A. KINCAID is farm field engineer, Portland Cement Association.

tion job, did the excavation work, mixed, placed and finished all the concrete work himself.

It has been agreed that our extension efforts should include showing the rural contractor, by means of a demonstration structure, how to build good concrete flumes. Once he has built one under supervision he is then trained and available in that community to build other structures. But until contractors have actually built concrete flumes they are hesitant about undertaking such jobs. It is evident that a demonstration job is required to acquaint them with the know how. It is practically impossible to instruct from pictures and words only. Models will help explain the idea. All of the demonstration jobs have been done with a crew of men not familiar with what the excavation should be like. In spite of this handicap not more than two days' time was required from start to finish of any of the demonstrations, unless rain interfered. A contractor with a trained crew can build them more efficiently.

The cost of construction for materials and labor will be approximately one-third the cost of the reinforced formed drop spillway type of dam when designed to do the same job. With contract labor and the contractors profit this cost would run a little higher than when regular farm labor is used.

Results and Conclusions. Of the 31 structures built under demonstration in Illinois in 6 yr, only one has partially failed. It contained no reinforcement. It was built during the early part of the war when no woven wire or reinforcing steel was available. Although the concrete has cracked, it is my belief that the failure was due to lack of maintenance.

The original argument that frost action would break up concrete flumes has been disproved. They have been used in the northern-most sections of the United States with no damage from frost. Over 100 structures of the type described are now in operation in Illinois, not including demonstration structures. No failures of any of these were reported in a survey recently conducted.

Observation of 31 structures over this six-year period indicates these following recommended locations for the now properly called "low-cost concrete flume":

1 At the lower end of grass waterways where the overfall is too great to be handled with a sod flume

2 At tile outlets where surface runoff occurs at the same location

3 In side gullies from natural or manmade drainageways

4 Individual terraces outletting into drainageways

5 Roadside overfalls.

The limitations of these structures are as follows:

1 Maximum overfall of 6 ft

2 Watershed of 25 to 100 acres, depending on the topography

3 Locations on solid undisturbed earth and where careful investigations indicate no porous strata

4 Locations with a stable grade in waterways below the flume

5 Notch width maximum of 16 ft.

It is best if the structure is used as a key part of a complete soil conservation program, not as the only conservation measure on the farm. No permanent erosion control structure is maintenance-free. Earth berms must be kept up to proper heights, rodent burrows filled up, and weeds mowed in waterways and on berms. However, no more attention is required on the flume than any other type dam. The construction of the berms and fills around the structure must be carefully done with sufficient overfill to allow for settlement.

Irrigation Research in Georgia

(Continued from page 302)

The corn yields increased with irrigation an average of 33 per cent. The 12-in spacings were significantly better than the 18 or 24-in spacings. Larger quantities of nitrogen in most cases increased the yield. Various fertilizer rates in conjunction with irrigation gave increases ranging from 21 to 39.8 per cent over the same rates on plots without irrigation. Hill spacing of 12 in in conjunction with irrigation produced 37 per cent more than when no water was applied; 18-in spacing on irrigated plots gained 38 per cent over the unirrigated; and the 24-in hill spacing irrigated gained 24 per cent over the unirrigated.

CONCLUSIONS AND SUMMARY

1 Although the annual rainfall averages 50 in in Georgia, drought occurrences, according to U. S. Weather Bureau records, are of such frequency as to warrant the use of supplemental irrigation. These long-time records indicate an average use of four irrigations per year on crops watered at 14-day intervals, and ten applications annually on those watered at 7-day intervals during the growing season from March to November.

2 Rotary sprinklers on portable pipe produce a variable distribution pattern at recommended spacings, varying from 1.5 to 3 in on an intended 2.0-in application. The velocity of wind influences the pattern considerably. From observation, however, the water was well distributed and wet the soil to at least a 6-in depth within a fairly short period.

3 In 1946 weekly applications of one-inch irrigations during periods of insufficient rainfall substantially increased vegetable yields. In spite of an unusually good distribution of rainfall, ten occasions developed during the growing season requiring the application of irrigation water. These gave increases from 12 per cent on early squash to 56 per cent on lima beans, 58 per cent on cucumbers, 60 per cent on okra, and 120 per cent on green pepper.

4 Two irrigations of corn in the wet 1946 season did not materially affect the yield of corn. Spacings, however, had a significant effect on total production. The 12-in spacing (12,445 plants per acre) had a significantly higher yield than both the 18-in spacing (8297 plants per acre) and 24-in spacing (6223 plants per acre), and the 18-in spacing yielded significantly more than did the 24-in spacing. In 1947 irrigation significantly increased the corn yields. Production was again highest with the closer hill spacings both with and without irrigation.

5 Irrigation of permanent pastures permitted carrying twice as many animals as on unirrigated pastures in 1947. The two-acre irrigated plot produced an additional 459 lb weight gain and 589 animal grazing days more than the unirrigated two acres from May 5 to September 15.

6 Pole beans, okra, and tomato yields increased significantly with irrigation in 1947, with a fairly dry season from July through September.

7 Significant yield increases were obtained with tomatoes and okra, both irrigated and unirrigated, by the use of soil fumigants for control of nematodes on infested land.

8 A supplemental irrigation system might have only a minimum of use and barely pay operating costs in certain years. During other years the crop-rainfall relationships may be such that supplemental irrigation will greatly increase yields.

Paradoxical Rivers of the Great Plains

TO a casual observer, the Great Plains rivers seem to defy all known laws of normal stream behavior. Instead of cutting their valleys deeper, they are, throughout much of their courses, engaged in filling them by depositing more material than they take out. The beds of their tributaries, instead of being at a higher level than the main stream, often flow, over a great part of their courses, at a lower elevation. As a result, instead of the stream branches working away from the main stream into the neighboring drainage system, they are likely to turn back and commit piracy on the parent.

The main stream, instead of remaining at a nearly constant gradient between high and low stages, increases its slope rapidly as the floods rise. Again, a tributary often has a broad, flat bottom with the stream meandering through it in a deep, narrow trench. To the student of stream work, this suggests rejuvenation, but in the Great Plains streams it means nothing of the kind. In this environment, it is the perfectly normal development of a degrading watercourse. The explanation of such seeming anomalies lies in the climate, the rock structure, and the nature of the sediments that cover the Great Plains.—From "The Paradoxical Rivers of the Great Plains," by Oren F. Evans, in The Scientific Monthly for July, 1948.

Suction Machines for Harvesting Almonds

By R. R. Parks and J. P. Fairbank

MECHANIZATION of California fruit industries over the years has enabled growers to compete readily in a price-conscious market and also to supply a quality product. Machinery now being developed for harvesting almonds is reducing the cost of production through elimination of hand picking. Moreover, the quality of the harvested nuts may be improved by their remaining on the trees until fully matured. They knock easier, and some growers claim fewer meats crack and split when the nuts are shelled.

As an indication of what can be accomplished with present machines, one owner picked 2200 lb of almonds last year in 4 hr, using one man on the machine besides himself. The man operated the machine from the front. The owner changed sacks at the elevator while riding on the rear platform. He claimed he reduced his cost to one-third that of hand-picking. This year he eliminated himself from the harvester by running the nuts direct into a two-wheel trailer which is towed by the machine. The trailer has a 64-cu-ft capacity bed. The machine covered a 50-acre orchard in less than two weeks time.

The forerunner of fifteen machines in California this year is a filbert harvester developed by Oregon State College. In 1946, three of the 15 machines were built in owners' ranch shops and operated with varying degrees of success for the season. During the winter and spring, all three machines were remodeled and, in general, did an excellent job of picking this past season. One point in common with all of them is the suction-nozzle design used on the filbert harvester. This nozzle starts with a 2 x 19-in flanged opening that rides 1½ in above the ground. Without gaining or losing cross sectional area, the metal nozzle shape changes to a 7-in round discharge opening which connects to a flexible hose at its upper end.

The machines vary in width from 5 to 8 nozzles depending on the distance between trees. The nozzle hoses deliver the nuts into a large enclosed chamber which allows the air to slow down and the nuts to be diverted from the air stream. Air with considerable dust, when working over loose ground, is discharged from the suction fan. The nuts fall usually into a rotary valve or "air lock" that works like a revolving door to dump the nuts either into a horizontal conveyor belt or into a screw conveyor which in turn feeds the nuts onto an elevator that runs to the sacking ring or trailer. Somewhere between the rotary valve and the sacking rings, the nuts are partially cleaned of clods, small sticks, and pebbles, by running them over an open metal elevator belt, a slatted-bottom elevator, or through a rotary wire screen, or merely by letting them fall on a sloping wire mesh screen ahead of the sacking rings.

There are at least three factors that influence the operation of the nozzles: (1) The shape and size of the flange around the opening determines the effectiveness of the air pickup. Most of the nozzles studied have 3-in flange sections ahead and behind the opening and 1½-in projections on either side of the opening, making 3 in between adjacent openings. Work in the laboratory and in the field indicates that less space is desirable between nozzle openings; and if dust pickup is to be reduced, narrower flanges are needed ahead and behind the nozzle openings. (2) The height of the nozzle tip above the ground is important. Air must move between the nozzle tip and the top of the nuts in order to give the lifting effect that first takes the nuts off the ground. There also must be enough volume of air moving toward the nozzle from behind the nuts to carry them into the air stream. It has been found that 1½ in above the ground is a desirable working height for the nozzle tips. The height is usually regulated by trailing gage wheels and a coil spring that supports most of the nozzle assembly. (3) The speed and amount of air entering the nozzle finally determines whether nuts will be picked up. By laboratory test and field check, it has been found that a flanged nozzle of the type generally used, when operating the correct height from the ground, will satisfactorily pick up nuts when air is moving into the nozzle at the rate of 4500 linear feet per minute. The effect of this air movement will register approximately 2½ in of vacuum on a monometer using water. Due to pressure drop in the assembly, most of the fans studied were required to draw a 5-in vacuum in order to hold a 2½-in vacuum at the nozzle tips. Assuming there is no air leak, a 6-nozzle machine should have a fan capable of moving 7200 cfm of air pulling a 5-in vacuum.

It is essential that the orchard be smoothed and rolled carefully for machine harvest. Loose clods reduce the efficiency of the machine.

Separation of the nuts from the lifting air begins at the point of entry into the plenum chamber, a large compartment where the air slows down and the nuts fall free or are diverted by grills set at an angle to the air stream. Most of the machines use a plain sloping grill of ⅜-in rods spaced approximately ⅜ in apart. Two of the machines use raking finger assemblies to keep the grill free of leaves and sticks, so the air will pass on through readily.

From the beginning, most of the machines have used rotary valves to remove the nuts from the plenum chamber.

This paper was presented at a meeting of the Pacific Coast Section of the American Society of Agricultural Engineers at Yuma, Ariz., February, 1948.

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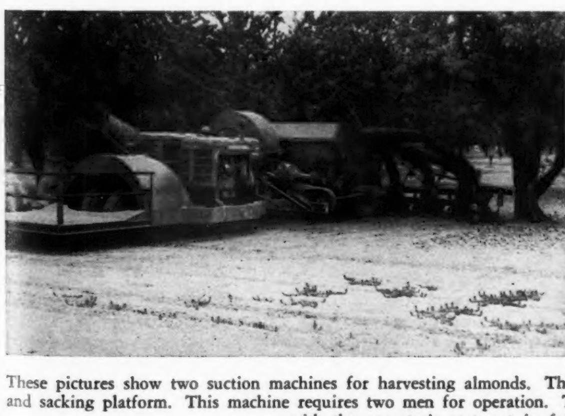
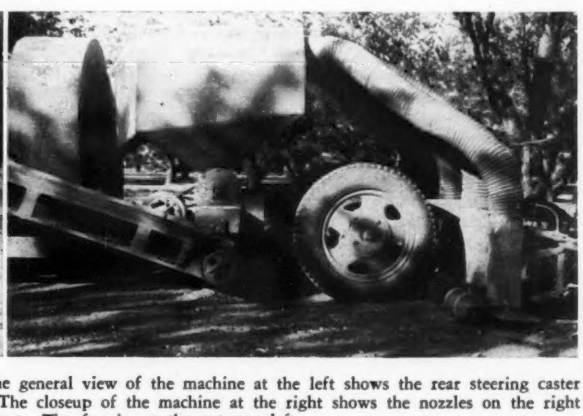

These pictures show two suction machines for harvesting almonds. The general view of the machine at the left shows the rear steering caster and sacking platform. This machine requires two men for operation. The closeup of the machine at the right shows the nozzles on the right with the operator's seat out in front. The fan is on the extreme left

Some of these had to be redesigned because of a tendency to make them too small or employ too many small sections that would choke with trash. The successful valves have a length equal to the width of the plenum chamber, are 9 to 10 in in diameter, and have four sections and large inlet openings. They have some stiff fabric material, usually belting, for their paddles. Two builders decided to enclose their cleated belt elevator and cross conveyor as a part of the plenum chamber and in that way do away with the necessity of having a rotary valve. The machine works with only a rubber flap about 18 in long being used to cover the upper portion of the elevator at its lower end to hold back the outside air. Considerable thought is being given to the elimination of the rotary valve in new machines either by the method just described or by enclosing a short section of the lateral screw conveyor at the discharge end.

The auger-type cross conveyor used by some builders has failed to work satisfactorily for lack of properly fitting the screw to its housing. A 3/4-in clearance between the housing and screw is left on some machines. In order to compensate for the inefficiencies of such a fit and to keep the unit from overloading, a speed of some 300 rpm seems necessary on the screw. At this point, it might be well to mention that, while V belts ordinarily give good service on farm machines because of their simplicity and the safety feature of slipping when something jams the machine, here the conditions of service are so dirty and the driving speeds so slow that chain drives with slip clutches are preferable.

It is desirable to give the nuts a partial cleaning before they reach the sacks or trailer. There are a number of ways of doing it. Some of the builders use a simple rotating cylindrical screen just ahead of the sacking rings. A most common and practical means is to clean the nuts in connection with their being elevated to the sacks or trailer. Several machines have slatted-bottom drag elevators made of 3/8-in half-round iron bars placed approximately 3/8 in apart. The flights are made of 1-in angle iron carried by two link-belt chains on the sides. This past season some builders tried patented belts made of metal segments, a type often used in canneries.

FAN IS IMPORTANT PIECE OF EQUIPMENT

The fan is the most important single piece of equipment on the harvester. Due to the abrasive action of the sand brought in with the air, the blades of the fan wheel and the housing must resist wear. The fan must pull the required vacuum with the horsepower available. At the same time, it should be as small as practical to keep the machine height down to a minimum so it can get under low hanging limbs. Only a few of the fans are homemade; most of them are commercially built and guaranteed as to performance by the manufacturer. It is important to remember that in addition to the abrasive effect of the sand and dirt picked up by the fan, the nuisance of the exhausted dust is one of the worst problems with the machines at the present time. The amount of dust can be reduced by lowering the suction in the machine; but, of course, this also lowers the efficiency of pickup. Laboratory work has indicated that the amount of dirt picked up can be reduced through elimination of the flange on the nozzle tip, but then suction must be increased to hold the same efficiency as before. The most effective methods for dust reduction are either to flood the orchard after smoothing prior to harvest or go to non-cultivation with herbicides. Two operators this year flooded their orchards after smoothing and found dust from their harvesters was reduced to negligible amounts.

Most of the machines have been equipped with industrial engines for the fan drive. Where automobile engines are used, some provision must be made for additional cooling with larger capacity fans and radiators like those on tractors of equal horsepower. The sizes required a range from 30 to 50 hp, depending on the size of the machine. Multiple V-belt drives seem to be the most popular. Because of the dusty conditions, large oil filters and the best air cleaners obtainable are well worth their cost and regular servicing.

Because of the slow speeds at which these machines move over the ground, little power is required to propel them. One builder equipped his machine with a 6-hp air-cooled engine and has power to spare. Others have taken power off of the fan engine to move the machine. Some have gone to the expense of supplying industrial or automobile engines for moving the machines. The first machines were driven from the rear, and the operator sat out in front of the nozzles and guided the machine with the front wheels. This method of guiding a long machine makes turning around at the end of the row difficult but enables the operator to work the nozzles closer to the trees. Swinging nozzles have been added to many of the machines for closer work between trees, so now the front end guiding feature is not so important. Some of the machines this year drive with the front wheels and guide with the rear wheels. At this point, it might be well to add that one grower has the men knocking to use a metal or canvas skirt around the tree trunk to put the nuts out where the machine can get them easier.

Only two machines thus far have replaced sacking with bulk handling. One has a trailer hitch that is unique in that the trailer bed always stays under the end of the elevator even when turning. This is accomplished by having a supplemental hitch on the corner of the trailer box which connects to a point on the elevator frame. The conventional trailer hitch is used in towing the load of nuts to the huller.

DIFFERENT VARIETIES PRESENT HARVESTING PROBLEMS

The different varieties in an almond orchard present problems in the management of machine harvesting. Where there is an occasional odd tree in the row, the operator stops long enough to allow the machine to clear itself, then fastens a sack over the end of the elevator to catch the nuts from the odd tree as the machine passes. In some orchards, where there is more alternate planting, this would be impractical and straight sacking would be advisable.

So far, no one has attempted to estimate closely the cost of owning one of these suction harvesters. One owner has estimated he could build another machine for $3,500. If that machine cost is written off in five years, there is an annual $700 to be charged against its use. If the machine covers 4 acres a day and requires 2 men to operate it, there will be a cost of some $6 an acre for labor and fuel. Then if some $200 is added to cover miscellaneous repairs, interest, etc., the total cost of harvesting, say, 100 acres of nuts would be $1,500, or $15 an acre.

There would be an advantage in allowing the nuts to stay on the trees longer because they hull easier and seemingly require no drying as in the case of the handpicked nuts. There is less worry for the owner over seasonal labor hiring. The hazard of north winds blowing the nuts off is eliminated because with machine harvest they are knocked on the ground anyway. Some growers claim the nuts knock for machine picking with about one-third the labor required earlier in the season. Some growers have been able to take their machine harvested nuts direct to the sheller. So it would seem that there are enough advantages to machine harvesting of almonds that the practice is here to stay, even though there are a few problems, such as dust, to be solved before the machines are generally accepted.

Obstacles to Research

THIS address began with the implication that nearly everyone is doing research now. But that is still far from being the case. Some of the several reasons why this is so, such as the high cost of research, failure to understand that in the long run it nevertheless pays for itself, shortage of qualified personnel, and the belief that only large organizations can do research, have been cited.

But, in conclusion, there is another important reason that may be mentioned. And this is that in some things our knowledge and our understanding have not progressed to the point at which we even know just what researches would be useful. We simply have not got that far yet in the slow evolution of our knowledge. — From "Research — Everybody's Doing It Now," by T. A. Boyd, in ASTM Bulletin for May, 1948.

Flood Surveys and Flood Control Operations

By John S. Glass

AUTHORITY vested in the Secretary of Agriculture by Public Act No. 738, 74th Congress, 1936, and including subsequent acts of 1937, 1938, 1939, and particularly Public Law No. 534, 78th Congress, 1944, really put the U. S. Department of Agriculture in the flood control business. A brief section of the original act which set the stage reads, "and federal investigations of watersheds and measures of runoff and waterflow retardation and soil erosion prevention on watersheds shall be under the jurisdiction of and shall be prosecuted by the Department of Agriculture under the direction of the Secretary of Agriculture."

Assignment of these responsibilities has been made to the Forest Service and the Soil Conservation Service, USDA. Watershed areas in which a principal interest is in forest or woodland are the Forest Service responsibility, while all other areas made up primarily of privately owned lands devoted to ranch or farm enterprises are handled by the Soil Conservation Service.

Areas now authorized by Congress in the several flood control acts referred to above include nearly every watershed area of the United States. Some of these authorizations cover a large area in a single sweep, for example, the Mississippi River. Others are not so large: Farm Creek in north central Illinois for example, has a drainage area of only about 60 sq mi.

The eyes of Congress have been on the Ohio, the Upper Mississippi, and the Missouri River basins for a long time. Certainly anyone from Nebraska, Iowa, Illinois, or Missouri does not need to call on his imagination to picture to himself the floods of June, 1947. In the past 3 to 5 years, the Missouri River has received a lot of attention. You recall the War Department's Corps of Engineers plan submitted by General Pick and the Department of Interior's Bureau of Reclamation plan submitted by W. G. Sloan, combined by action of Congress into what is popularly known today as the Pick-Sloan Plan for the Missouri Basin.

The sum total of a lot of things, topped off by the President's address to Congress in July, 1947, has resulted in a definite concentration of effort designed to lead to flood control in the Missouri, Upper Mississippi, and Ohio basins.

Steps in flood control procedures may be briefly listed as follows:

1 Congressional authorization of a watershed for investigation

2 Appropriation of funds for investigation

3 Preparation of a preliminary examination report by the Forest Service or Soil Conservation Service, according to previously assigned territory

4 Preparation of survey report

5 Approval and authorization by Congress of works of improvement

6 Development of work plans

7 Congressional appropriation of funds for construction

8 Application of flood control measures.

The purpose of this paper is to discuss flood surveys as we make them and to follow that with a discussion of how we are proceeding to put one of the jobs through the phases of establishing it on the land. That job is being done on the Little Sioux Watershed in northwestern Iowa. The area is authorized by Congress, and the Secretary of Agriculture has named the watershed for operations.

A part of the job on which we are now working is the Osage River basin. The Osage is a tributary of the Missouri, draining an area of about 10,000 sq mi of Missouri and 5,000 sq mi of Kansas. This refers to the Marias des Cygnes River.

The Preliminary Examination. The objective in making preliminary examinations in authorized watersheds is to determine whether a remedial program of waterflow retardation and soil erosion prevention in the interest of flood control appears to be sufficiently feasible to warrant further investigations.

Actual data are secured from reliable sources, and a brief field examination is made. Floods and flood damages are discussed with residents of the area, representatives of city, county, state, and federal agencies, and utility organizations serving the watershed.

There are several questions, all of which must be answerable in the affirmative before a recommendation for a survey can be made. They are as follows:

1 Are flood and sedimentation damages which occur, within and outside the watershed, and which may be traceable to the watershed, of sufficient magnitude to warrant further federal study?

2 If so, are these damages related in a significant degree to watershed land use and erosion conditions?

3 Would watershed treatment result in sufficient flood water and sediment reduction to be of substantial benefit?

4 Does the degree of advantage, in terms of probable total benefits from the program compared to the probable total costs, appear to be sufficient to warrant further investigation?

5 Do the present land-use activities and programs in the watershed need assistance to solve adequately the flood and sedimentation problem within a reasonable period of time?

6 Would irreparable damage occur to land resources and downstream structural improvements before present land-use activities and programs could solve adequately the flood and sedimentation problems?

7 Are the attitudes of the affected people, including farmers, landowners, and officials, such that cooperation in the execution and maintenance of a flood control operations program is likely to materialize?

We made the preliminary examination of the Osage River basin and recommended that a survey be conducted. We further recommended that, due to the urgent request we had received from the Corps of Engineers and others interested in the Missouri basin, we start the survey at an early date. That recommendation was made in May, 1947, and we were ready to go, with the funds available, shortly after July 1.

During the interim, May to July, we began accumulating climatological reports, stream gaging records, soils information, infiltration data, and maps. We also did a few other jobs all in the classification we term advance studies.

The Survey. The first actual work in the area was the preparation of a reconnaissance conservation survey of the entire 15,000-sq-mi area, from which we made a physical land unit map. A physical land unit is an association of soil, slope, erosion, and other conditions in which under similar cover and treatment there is an essentially uniform pattern of runoff, sediment production, and deterioration of soil resources.

We settled on a grouping that resulted in establishing nine physical land units in the Osage basin.

When a watershed under study is small, we investigate the entire area. When dealing with large areas such as this one, we use a sampling procedure after the physical land unit area map has been prepared.

Physiographically the entire basin is divided into four areas, and five tributary watersheds were selected for hydrologic and sedimentation studies. Valley cross sections are run in these tributary watersheds in accordance with ranges established as representative of valley conditions. These cross sections are used in flood damage appraisal by the hydrologists, economists, and others, and in estimating sedimentation accumulations and channel aggradation.

This paper was presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1947, as a contribution of the Soil and Water Division.

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Seventy areas, of 3 sq mi each, were selected by an approved sampling procedure from the four physiographical delineations. In these sample areas the present natural water-disposal systems are studied and programs for their stabilization are determined. Gully erosion damage is evaluated and a program of gully control devised.

Each of the physical land unit areas was sampled in one-quarter section units. A total of about 400 such areas was selected. These sampling procedures were developed through consultation with the statistical laboratory, at Ames, Iowa. A study of the samples in the field has convinced us that the method used is satisfactory.

The sample one-quarter sections have been surveyed by our soil scientists following the procedures used in the preparation of conservation surveys, regularly used in the development of conservation farm plans. One added feature is included, that of showing sedimentation accumulation. The detail surveyed areas are then planned in conformance with "assignment of each acre to its best use, and the treatment of each acre in accordance with its needs for maximum retention of water on the land, and a reduction in soil losses."

The development of this phase of the survey gives the land-use adjustments required and the cropping pattern to be recommended, along with the necessary retarding treatment for watershed runoff to be applied on the land.

Throughout these on-site studies of the physiographical delineations, the tributary watershed, the 3-sq mi sample areas and the one-quarter section units, special attention is given to the location of possible sites for the advantageous use of waterflow-retarding structures. These sites are later studied and their flood control value determined.

Urban, highway, railroad, drainage district, irrigation district, and other flood damage data are secured and evaluated.

For the sake of uniformity, prices as of the date of the report are used, all evaluation work, both in determining monetary value of damage sustained, and in estimating the costs of the recommended program.

The survey report is a brief summary document, including the following:

1 An outline and location map of the area
2 Introductory paragraph showing (a) the authorization under which the survey was conducted and (b) the purpose and scope
3 Recommendations
4 Description of the watershed
5 Statement of the flood problems
6 Activities in the watershed related to flood control
7 Proposed program
8 Monetary benefits from program
9 Comparison of benefits and costs.

This is the form of the printed document issued upon approval by Congress. All of the summarized supporting data including explanations of methods and procedures followed in conducting the survey and analyzing field data, are contained in the appendix to the report. This document is seldom reproduced in printed form, but is maintained for reference purposes by the federal agency responsible for the survey.

HIGHLY COMPETENT FIELD STAFF MAINTAINED

We maintain a highly competent staff in the field. We make the field investigations, analyze our findings, prepare a program applicable to the area, arrive at conclusions, decide on recommendations, and prepare survey reports in the field.

A small staff of consultants under Homer M. Wells, chief of the water conservation division, Soil Conservation Service, is available to us from our Washington office.

Throughout the survey, as commitments will permit and special problems dictate, we consult with our Washington staff, call upon the U. S. Forest Service or any other federal or state agency for council, guidance, and review. Throughout the survey we maintain close relationships with all federal, state and local agencies, to insure careful correlation of our activities with those of others who are interested in the development of the watershed. For example, in our survey of the Osage basin we are working closely with the (1) U. S. Corps of Engineers, (2) U. S. Forest Service, (3) Missouri Resources Development Commission, (4) Missouri Conservation Commission, (5) University of Missouri (College of Agriculture), (6) Kansas Water Commission, (7) Kansas State College, and others.

FLOOD CONTROL IN THE LITTLE SIOUX BASIN

The Little Sioux River is an immediate tributary of the Missouri River. Nearly all of its watershed is within the State of Iowa; however, the extreme upper end, consisting of about 195,200 acres, lies across the Iowa-Minnesota state line, being part of Nobles and Jackson Counties, Minnesota. The entire watershed includes roughly 4,500 sq mi.

Strictly in accordance with the procedures I have just mentioned, a survey was made of the Little Sioux. The proposed program was submitted to Congress and authorized in Public Law No. 534, dated December 22, 1944.

The war caused about a year of delay. It was November, 1945, when we were instructed to get ready to start the preparations of work plans to be submitted for budget purposes.

Authorization of the Little Sioux program is for the use of $4,281,000 in federal funds. There is considerable difference between a Congressional authorization and a Congressional appropriation of funds. Funds are made available on an annual basis, and are provided only in conformity with work plans submitted to substantiate requests for the money.

We were given a small budget to get things started toward the preparation of work plans. It was understood that no contracts would be considered until after the war.

We were successful in placing a small crew of technicians in the Little Sioux area, and had our first work plans ready on schedule, but a lot of things happened between November 1, 1945, and July 1, 1946.

By January 1, 1946, we had located two or three of the men who would be handling flood-control phases of this undertaking, and had developed our plans for carrying out this important assignment through our established procedure of furnishing assistance to soil conservation districts.

On January 3, 1946, the Iowa State Soil Conservation Committee (established in accordance with the Iowa Districts Law) called a meeting in Sioux City, Iowa.

The purpose of this meeting was to (1) familiarize the people with the flood control program that had been authorized by Congress (2) present a procedure by which we believed we could accomplish our assignments, (3) describe the responsibilities to be assumed by the local people, and (4) get some suggestions and reactions from those in attendance as to how they believed they could meet the requirement of the authorization.

Attendance at this meeting included (1) the state soil conservation committee, (2) the officers of the established soil conservation districts in the watershed, (3) the county extension agents from each of the counties, (4) cooperators from the soil conservation districts, (5) members of Farm Bureau boards, and soils committeemen from counties not yet organized in soil conservation districts, (6) Iowa State College representatives, and (7) representatives of the Soil Conservation Service.

Earl Elijah, chairman of the state soil conservation committee, presided. This was an all-day meeting and more than half the time was devoted to constructive discussion of "how to get this job done."

It was pointed out that, of the entire Missouri Basin, the watershed of the Little Sioux, was the only area in which the Department of Agriculture had a program ready to apply on the land that was designed to relieve the area of much of the burdensome load, the results of floods. Certainly there was full recognition of the fact that we had a tough job ahead. But the entire trend of discussion was always toward accomplishment.

Following much discussion, it was proposed that the chairman name a committee with membership from each of the soil conservation districts, and from the counties not yet having organized districts, to serve as a guiding committee representing all interests in the watershed. Mr. Elijah suggested

that one committee member be selected from the offices of the existing soil conservation districts, and that the county extension agent and the Farm Bureau soils committee select a member for each of the unorganized counties. This was done. Almost immediately this committee was named the "Work Committee" (the name has stayed with them). They have earned the title.

Here are some of the things with which this committee is charged:

1 Maintaining close relationships with soil conservation districts and other county agricultural organizations

2 Preparing resolutions of local participation and submitting them to the Secretary of Agriculture in conformance with the law

3 Studying educational requirements and securing assistance from the agricultural extension service

4 Working with soil conservation districts in the establishment of priorities on subwatershed areas for flood control work

5 Determining extent of local participation required and that desirable to meet the law and maintain a high degree of interest in the complete job

6 Maintaining cooperative participation throughout the watershed.

The establishment of priority of subwatershed areas is an important continuing function of this committee. They have established just two rules that they adhere to strictly:

1 Each subwatershed must be at least 70 per cent under conservation farm plan with the local soil conservation district

2 The application of the program on the land must be to the satisfaction of the soil conservation district governing body. (Of the 37 subwatersheds that the work committee has certified, the entire area, not 70 but 100 per cent is under farmer-district agreement.)

In the organization setup of the Soil Conservation Service, we have a state office headed by a state conservationist and his assistants. One of these assistants in Iowa is in charge of all flood control work in the state. Then there are district conservationists who are responsible for all service activities in from 3 to 5 soil conservation districts. These are called a work group. And in each soil conservation district we have what we call a planning unit. This unit usually consists of a soil conservationist (we often call him the farm planner) and his aids. Serving a larger area, often two or more work groups, we have specialists—most of ours in this region are engineers. In handling the flood control operations program in the Little Sioux we have made the required specialists available in the area.

HOW APPLICATIONS FOR ASSISTANCE ARE HANDLED

Now let's take one of the small areas through, from application by the farmer for assistance, to the completion of the job of establishment of "measures for runoff and waterflow retardation and soil erosion prevention on watersheds."

Applications for assistance, are accepted by the soil conservation district governing body, when landowners or operators of a small watershed group indicate their desire by presenting a written signed application.

A meeting is held in the small watershed (usually conducted by a representative of the Extension Service) with a member of the soil conservation district governing body assisting. If the interest is good, the new watershed is reported for the development of a watershed program.

In order to get this job started off, to include flood control features as well as soil and water conservation, one of the specialists referred to above is called in. He and the Service representative who will work with the group of landowners and operators, on the development of their programs, study the entire area together. They are on the alert for several things:

1 The establishment and protection of an adequate water-disposal system for the entire area

2 Those areas that are recognizable as high contributors of runoff

3 Areas that are hazardous from the standpoint of soil erosion and the production of sediment.

Many of the problems these men make note of require cooperative participation on the part of two or three or more adjacent landowners for their accomplishment and successful maintenance.

With this assistance the soil conservationist (farm planner) is ready to start with the watershed group in the development of their farm land programs.

When this planning job is completed and the farmer-district agreements signed, the work committee is notified by the district conservationist through the local soil conservation district governing body. In this manner the work committee is in position to tell, on inspection of their records, how many subwatersheds are working toward establishing themselves on the priority list. They now have more than seventy such areas on their list. The committee has certified about thirty-seven to us.

When this small watershed group has demonstrated to the satisfaction of their local soil conservation district governing body that they are actually getting their job established on the land in accordance with their plan, the second important step is recommended. The local soil conservation district notifies the work committee that the subwatershed is ready to go ahead. At this time the work committee gives the area a priority number, and the district conservationist requests assistance again from the group of specialists.

WATERSHED WORK PLAN IS IMPORTANT DOCUMENT

At this time all of the field investigations are made that are required for the development of work plans. The work plan for a subwatershed is an important document. It includes the plan of land-use adjustments, resulting in the assignment of each acre of farm and ranch land to the use for which it is best suited; the design of the cropping pattern to be followed; the supporting conservation practices, such as contour farming, strip cropping, terracing, etc., required to maintain the soil resources of the area, and retard runoff and reduce soil losses by erosion; and the use of upland water courses primarily protected by vegetation. All of the above items may be of a classification that may be accomplished on a single farm or ranch.

The work plan also presents a solution for one or more group jobs. These are jobs that require cooperative effort, but may still be accomplished by the group of landowners without financial assistance. The major subwatershed water-disposal system nearly always calls for the solution of difficult problems, many of which cannot be handled by small groups. In most instances these solutions have a definite downstream effect in reducing peak quantities of runoff and accompanying sedimentation. These plans are prepared and submitted to Washington with a request for the estimated amount of money required for the federal part of the job. These are the plans that must be available as the basis for the annual budget requests presented to Congress. We have submitted seventeen of the subwatershed work plans.

Following favorable consideration of the budget request by Congress, funds are made available for flood control operations, including the preparation of detailed designs for construction, the preparation of specifications, and invitations to bid for the special flood control measures to be done by contract. Regular government procedure is followed in the advertising and distribution of bids, and granting of contracts.

We opened our first bids on the Little Sioux last June 30, and the contractor started work on the job on August 18. The job was 41 per cent complete November 1. All but the establishment of vegetation will be accomplished before winter closes down operations. This part of the first contract to be awarded will be done next spring.

Right now our field engineers and designers are busy on the preparation of detailed designs on jobs to be let this winter and early next spring. Our plans call for about a million dollars in contract work each year until the job is complete. The original estimate of six to seven construction years still stands.

Engineering as Related to Farm Management

By W. D. Davis

IN ORDER to have a clear understanding of just where an agricultural engineer fits into the work of a professional farm management organization, it is first necessary to know something of the work of a professional farm management company.

The first task of a farm management organization is to manage farms. In taking over the management of a farm, the fieldman inspects the property, including the buildings, fences, water supply, and the soil. Then on the basis of this inspection, he develops an operating program for the farm.

In many cases, the next step is to secure a tenant to whom he can rent the property for cash for the buildings and pasture, and for a share of the crops on the crop land. This operation is relatively simple and results in the handling of the farm by the tenant in accordance with the operating plan. During the course of the season, the fieldman makes many inspection trips and consults and advises with the tenant on many occasions. He collects the rent due the owner and remits it to the owner. In addition, taxes and insurance are handled as a matter of office routine, as well as AAA applications and other problems in connection with the farm.

In many other cases, however, the management problem becomes somewhat more complicated, in that instead of renting the farm, it is operated under a stock-share lease or a partnership. Under this arrangement, the landlord, as represented by the farm management company, owns one-half the livestock and feed and pays for one-half of the operating expenses, even including gas and oil and the ordinary run of machinery repairs. Under some arrangements, the landlord even owns an undivided one-half interest in all the machinery. Thus the management is faced with the problems of crop production and soil rebuilding practices, and has the further responsibility of keeping a check on machinery costs and operating efficiency. The time the fieldman is required to give to the farm is increased considerably, and the reports received by the management from the farm are much more frequent. Reports to the client are on a monthly basis, so that the owner of the property is familiar at all times with just what is going on.

In a few cases farms are operated by direct labor. A foreman is hired to supervise all farming operations. The landlord, as represented by the farm management organization, owns the machinery and livestock, as well as the farm, and provides all the operating capital. Such an intensive operation makes heavy demands on both the time and knowledge of the fieldman.

In addition to actual farm management, a professional farm management organization also serves many clients in an advisory capacity. That is to say, the owner operates the farm himself, but he has the advantage of the experience and training of the fieldman at agreed-upon intervals to assist him in working out the various problems in connection with his farm. These problems involve everything from soil building and maintenance through building design, construction, and maintenance, all the way down to tax problems. Any problem that is troubling the farm owner is placed in the hands of the fieldman for a solution. This places a heavy demand on his knowledge and experience.

Professional farm management organizations are logical appraisers, because of the training of their staffs in the work of managing farms. Since much of the value of a farm is determined by its earning capacity, it is obvious that a manager who has had wide experience in the ability of farms to earn under varying conditions is qualified to make such a calculation. Therefore, professional farm management organizations are leaders in the rural appraisal field and serve widely in the appraisal of farms for purchase, for sale, for loans, in condemnation, and for all other purposes for which appraisals are made. In many instances, the experience of such organizations has been such that they have been called upon to appraise industrial installations and semi-industrial installations closely related to agriculture in many parts of the world.

Another activity of a farm management company is that of the purchase and rehabilitation of farms for investor accounts. Acting on behalf of an investor, the company locates farms that can be purchased below the market and are in need of rehabilitation. The management arranges the purchase for the account of the investor, rehabilitates the property, and offers it for sale. Such profits as may be derived from the operation may be divided between the investor and the company with the result that both share in accordance with the contributions they make. The seller of the farm benefits because he sells an undesirable unit which few will buy. The buyer also benefits because he buys a rehabilitated unit that is ready to go.

There are many other activities of a professional farm management company, including economic studies, agricultural editing, special research, and testimony before governmental boards. The activities discussed above are those in which the agricultural engineer finds his work in connection with farm management.

Before an agricultural engineer can fit into a farm management unit, he must meet many unusual qualifications. It is not enough for him to know how to use the various engineering tables, to be able to calculate stress and load, or to determine the ability of earth to carry certain weights.

He must be, first of all, a farmer. That is to say, he must have the country viewpoint and approach to the engineering problem. This is an extremely difficult qualification to find. It is necessary, however, for him to have this approach, because in all his calculations and in his work the result should meet country standards and needs. There are many men who know the engineering tables and theories forward and backward, but there are few who know how to meet the country need. It is tragic that even these few, unless they are kept constantly in the country with the dirt on their feet, soon lose their touch.

A well-trained and well-qualified agricultural engineer fits into the personnel of a farm management company in farm operations.

In the matter of equipment there is much yet to be desired. Design and construction are often quite faulty. For example, a certain very capable manufacturing firm put an automatic baler on the market. From an engineering viewpoint it was a marvel, but when it got to the country it literally fell to pieces after the first 5,000 bales. The unfortunate owners found that by taking the machine in to be welded and by redesigning and strengthening the various braces and parts, they could make the machine stand up. This cost the purchasers many thousands of dollars and resulted in a feeling of distrust toward the products of the manufacturer. No doubt their engineers were experts on design, but they forgot that in the country a piece of machinery has to "take it." Had they put the machine in the hands of a professional farm management company with instructions for their engineers to check the machine for design, construction, operating cost, and operating stamina, the purchasers would have been saved the expenses they encountered in making the machine stand up.

It is not intended that this statement be considered an indictment against machinery engineers, but rather a matter of calling to their attention their own shortcomings. They

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can not possibly view a piece of machinery through a farmer's eyes because they are not farmers. They can, however, supplement their own efforts by sending their machinery out in the field, not in the hands of their own operators, but in the hands of an agricultural engineer working with a professional farm management company, to properly locate the "bugs" and point out the errors in design. Many other examples could be related. Even so large an organization as the Caterpillar Tractor Company followed this program in the introduction of their new motor grader. They thought they had a perfect machine until they placed it in the hands of the agricultural engineer working with a farm management organization. They soon found just what the machine could do and just where its weaknesses were, and as a result their new machines are coming out with those weaknesses corrected.

Building construction and design is a major farm operating problem and one which demands the utmost in attention and consideration from agricultural engineers. How much per cow or per sow can we spend for a building? How long must this building last? Must it be permanent or movable? How can existing structures be properly remodeled to meet modern demands? How much per machine can we pay for storage? And what kind of construction will such a payment permit? All of these problems are far from being answered. They will not be answered by design or construction engineers. They will and can be answered only by agricultural engineers working in and with professional farm management organizations. By having dirt in their ears and mud on their shoes, and by knowing by experience farm operating problems, such men can develop solutions to the problems.

From the viewpoint of farm operation, we still need a lot of careful study on the proper use of electricity. One may say, "Why not let an electrical engineer make such a study?" Unfortunately, however, he knows not the first thing about the endpoint, the work done per dollar for the use of the commodity. Only a man versed in farm operation is able to determine the proper results and to definitely locate that point up to which we must go in the use of electrical equipment and beyond which it is not economical to go. An agricultural engineer fits in well with a farm management organization in this type of study, because he is able to view it as an entire problem and not as a problem of the individual appliance. He is therefore able not only to design the necessary electrical installation, but to determine its economic usefulness so that just enough and no more is used.

MANAGEMENT MUST EARN PROFIT FOR OWNERS

We long ago learned that in the operation of farms, if we are to continue to serve the owners in their management, they must make a profit year after year, and a substantial one. We further learned that it is impossible to make a profit with worn-out soil. After spending many dollars for fertilizer and clover on rolling soil, we learned that we lost about one-half of everything we put on the ground through leaching and erosion. Obviously the problem was to keep it there. One answer was through an increase in organic matter. But we couldn't get an increase in organic matter without the increase in mineral content of the soil, through the use of fertilizers and lime so that the legumes would grow, and we couldn't get an increase in the mineral content unless we could keep fertilizer in the soil. Obviously the only answer was terracing. Our original attempts at terracing were rather clumsy and were not satisfactory. Certain fields were terraced without regard to the farm as a whole. While we knew we had to have terraces, we finally found that, after we had the terraces, we had a farm that wouldn't work.

This is perhaps the most important problem in modern agriculture that the agricultural engineer has been called on to help solve.

Such engineers working in cooperation with farm management organizations have learned to develop a sound water management program for an entire farm and after developing such a program, it has been possible to so design the terraces, waterways, and structures for the individual fields that they all fit into the picture.

However, this still has not been enough. Costs have been entirely too high. It is now the problem of the agricultural engineer working with farm management to develop ways and means of reducing costs so that the endpoint of increased profit may be realized. Nothing is gained in increasing the physical production of the property if it takes all the increased production to pay for the cost of increasing it. Progress has been made along this line, but much more yet remains to be done.

The engineer has the problem of not only designing machinery but of designing the method of handling it so that excess operation expense can be eliminated. His work along this line runs not only to the improving of terraces, waterways, and diversions, but also to the point of getting the job satisfactorily completed. A case in point is that of waterways. A great majority of the waterways constructed each year are complete failures. Dirt farmers are notorious in their unwillingness to take the steps necessary to make waterways so that most of the grass will stick. Thus modern agricultural engineers are faced with the problem not only of constructing the waterways, but of building them satisfactorily, and then of seeding them so that the farm receives a better job and so that most of the waterways can be expected to survive.

The agricultural engineer has the problem of designing and constructing structures. His work has resulted in the development of the thin-section concrete spillway, and the morning glory and tube. Even these structures are too expensive. More economical structures must be developed and will be developed by agricultural engineers, working with farm management, because only they are conscious of the importance of cost in the result.

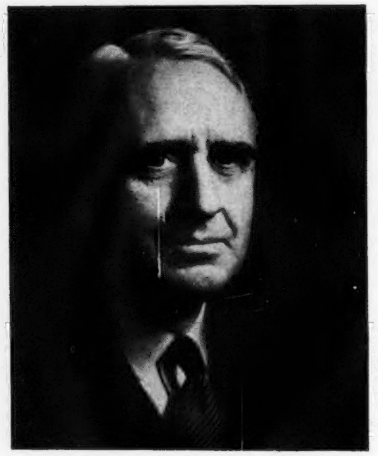
AG ENGINEERS NEEDED FOR PONDS AND ROADS

In our experience, also, agricultural engineers have been of value in the designing and construction of ponds and roads. Most people think of a road as a simple thing and of a pond as a dammed-up gully. Experience has shown both conceptions to be wrong. A pond properly located and properly constructed with a pipe in it and a good tank below it is a joy to any farm and pays for its cost many times over. A pond that merely stops a gully is a mudhole at best and has only temporary helpfulness. A road constructed to proper grade and with proper drainage solves many operating problems. One that simply runs like "Topsy and Eva" is an abomination. The same is true in connection with creek crossings, fences, and in the design and construction of feed lots.

In the appraisal field, agricultural engineers are beginning to find their place. They are of invaluable assistance to the appraiser in determining building replacement costs. They are even of greater assistance to the appraiser in determining the cost of substitute buildings which might be more typical under modern agricultural conditions. They have been of invaluable assistance in determining physical depreciation and because of their close association with agriculture have been helpful in judging obsolescence. But again, not just any engineer will do. He must be an agricultural engineer with dirt in his ears and mud on his feet and with the country viewpoint. Otherwise his recommendations will be false and the conclusion unsound.

We found long ago that we needed the service of an agricultural engineer. We now have two of them. They have been of invaluable assistance in enabling us to offer complete service to the owners of rural property, because they have had their feet on the ground. They have been of assistance in the matter of equipment, buildings, and electricity, as well as the problems in connection with water management and appraisals. As our men gain more experience in agriculture, their value to us will increase and, as we gain more knowledge as to how they can better assist us, we will continue to work together more closely for the greater service of agriculture.

The 1948 A.S.A.E. Gold Medalists



The American Society of Agricultural Engineers awarded the John Deere Medal to Dalton Miller and the Cyrus Hall McCormick Medal to Roy Bainer on the occasion of its annual dinner on June 23, held at Portland, Ore.

D. G. MILLER

ROY BAINER

LIKE many prior awards, bestowal of the John Deere Gold Medal on Dalton Giles Miller gives recognition to a lifetime of noteworthy work in the service of engineering to agriculture. Awarded annually by the American Society of Agricultural Engineers, the 1948 award of this medal has a special measure of inspiration, as it shows how devotion to an assignment led a man to become a world authority and cut a pattern for a great step forward in a basic industry.

Born May 7, 1880, at Guthrie Center, Iowa, Mr. Miller is of truly Midwestern pioneer stock, for one of his maternal ancestors came to Polk County in 1818 while his father's folks came to Guthrie County in the early fifties. His father was county superintendent of schools for eight years during the seventies, while his mother taught school in the sixties in a building located on what are now the capitol grounds.

Dalton G. Miller took his high school training at Guthrie Center. He was graduated from the University of Iowa in 1905 with the degree of B.S. in civil engineering, and in 1924 was given the C.E. degree by the same institution.

It was on October 16, 1906, that he received an appointment in the U. S. Department of Agriculture. For nearly four decades he served continuously in the Department, until his transfer, July 16, 1946, to the Public Roads Administration. He started work in the Department with the Division of Irrigation and Drainage, following its organization migrations from the Office of Experiment Stations, through the Bureau of Public Roads, of Agricultural Engineering and its successor alignments, to the Soil Conservation Service.

During these years, his official assignments were widely distributed in the South, Middle West, and Far West in 22 of the 48 states and covered just about every phase of drainage engineering. In 1908 he was sent west to work on problems of drainage and reclamation of water-logged irrigated lands. From 1908 to 1916 his official headquarters were in Colorado, first at Grand Junction and later at Denver. While in Colorado he helped write the first comprehensive drainage law enacted by that state and was closely identified with the creation of the first four drainage districts organized under the new law. His mimeographed report and recommendations for draining and reclaiming certain high salt content soils of the Grand Valley, Colorado, is outstanding in its thoroughness based on field studies and experiments that covered the better part of six years. During 1913 and 1914, he supervised all phases of the engineering involved in the drainage by underdrains of a 5000-acre drainage district located in the southwestern part of the San Luis Valley of southern Colorado. Some of this area produced a wheat crop of nearly 50 bushels to the acre the first year after drainage. In 1914, he and an engineer of the U. S. Reclamation Service were especially delegated, respectively, by *(Continued on next page)*

IN THE 1948 award of the Cyrus Hall McCormick Gold Medal to Roy Bainer—an award made annually by the American Society of Agricultural Engineers—the profession and the society representing it mark a milestone of maturity. It is the first time that such recognition has been bestowed on the second generation, Roy's father, Harry M. Bainer, being the veteran agricultural agent for the Atchison, Topeka & Santa Fe Railway and one of the charter members of the American Society of Agricultural Engineers.

Roy was born March 7, 1902, near Ottawa, Kansas. He attended grade schools in Colorado and Texas, while his high school course was divided between Amarillo, Texas, and Topeka, Kansas. His higher education began in 1921 at Kansas State College, where he took one year of general agriculture before transferring to the professional agricultural engineering curriculum.

Getting his bachelor of science degree in 1926, he remained at Kansas State as instructor in the department of agricultural engineering, continuing his engineering studies to earn the master's degree in 1929. By that time he had been for two years an assistant professor and assistant agricultural engineer in the engineering experiment station.

In the same year and with the same titles he joined the University of California and its allied agricultural experiment station. Except for dropping the "assistant," he has continued at California in the same capacities, and since July 1, 1947, he has been head of the division of agricultural engineering in the college of agriculture at Davis. There he has earned high esteem for his talent as teacher, that vital aspect of engineering wherein genius too oft is slighted because its achievements are difficult to define. His inspiring and thorough instruction builds up basic theory upon practical examples drawn from his rich industrial and research experience.

That experience, by the way, began before and continued through his collegiate career. Early in his teens he spent three summers as a field worker for the USDA Cereal Experiment Station at Amarillo, Texas. Later he worked on the assembly and test floor for two manufacturers of engines, and served as a field service man for a tractor manufacturer. Starting in 1919 and continuing through 1924 he operated a farm in western Kansas as a side line to his college program, producing, during that period, over 16,000 bushels of winter wheat with the aid of modern power machinery.

Somewhat the same policy of proceeding from the practical problem through study of related theory seems to have guided his research work. And closely akin to his talent as a teacher has been his knack of inspiring and guiding his associates in research. Indeed, he is at pains to insist that in many if not most of his notable developments he has been but one of several participants.

However much he may share the work and the glory, associates in position to speak with well-weighed judgment give him major credit for several studies resulting in substantial advances, technically and economically, in agricultural practices. One such was the problem of the poor milling quality in rice.

Bainer's painstaking analysis of the condition revealed that it came from checking, caused by exposure to the sun while standing as bound bundles in the shock. He then devised a windrow-harvesting method whereby the heads were rolled inside the windrow. It reduced not only the sun damage but also the costs of harvesting.

This development paved the way for rice harvest by direct combining, followed by artificial drying. This latter operation was based on methods used in Italy, and here again it was Mr. Bainer's report on the foreign practices that provided the pattern for drying equipment. With these and other driers the entire California crop of some 5 million tons is now processed as regular routine.

In another development he collaborated with Dr. H. A. Borthwick, who already had learned that "bald head," "snake head," and other defects in lima bean seedlings were the result of concealed damage to the seed beans. The two men made field and laboratory tests to measure the impact forces great enough to cause the internal fractures. Bainer continued with analysis of the threshing process to find where such forces were applied to the beans.

As a result he was able to suggest changes in design, including the rather revolutionary rubber rolls, and in the operation of threshers to avoid these impacts. The rubber rolls have been put into practical use not only for beans but for flax. Whereas damage to beans had generally been 15 to 20 per cent, the improved methods cut it down to a range of 2 to 5 per cent.

BAINER'S WORK REDUCES HAZARDS FROM SPARKS

The same analytical approach carried through to practical working data characterized a less momentous problem, that of fires started by sparks from the exhaust of internal-combustion engines. Working with J. P. Fairbank, measurements were made of the size of carbon particles emitted as sparks, their temperatures in various trajectories, and the relation of these values to kindling of various types of ground cover under varying atmospheric humidity. These studies have become the basis for judging and for design of spark arresters, and thereby are reducing fire hazards in fields and forests.

Bainer's way of going all the way back to the beginning of a big problem is well shown by his more recent and more dramatic work in the realm of sugar beet machiney. According to one of his associates, his major goal was mechanical harvesting. Prerequisite to that was reasonable uniformity of size and spacing of single beets in the row. So he went to work on what to do about seed balls that contain anywhere from one to six germs.

Since the individual seed unit, as well as the multiple seed ball, is not uniform in size, a superficial process of grinding and screening falls short of yielding individual seeds. Bainer discovered that the seed ball could be reduced to segments, each containing approximately one germ, by forcing the seed past a stationary shear bar. It was a problem both of engineering analysis and inventive ingenuity.

Machinery for the method was devised, and in 1941 was used to prepare enough of the sheared or segmented seed to plant one acre. So avid were beet growers and sugar companies in adopting the new method that four years later 90 per cent of the nation's sugar beet acreage was planted with sheared seed, and resulted in an annual saving of hand labor (for thinning) estimated at 9 million man-hours.

While the nation was accepting the new seed, Bainer recognized certain inherent weaknesses in the process. Further work resulted in an improved process known as decortication. Seed processed by this new method was issued for the first time this year by all sugar companies operating in California as well as several companies operating in other sections of the country. *(Concluded on next page)*

D. G. Miller — 1948 Deere Medalist

(Continued from preceding page)

the Secretary of Agriculture and the Secretary of the Interior to prepare a confidential report on several aspects of water utilization of the San Luis Valley.

During the spring of 1919, failures of some large-diameter drain tile were reported to have occurred in southwestern Minnesota and a number of interested agencies jointly requested what was then known as Drainage Investigations of the Bureau of Public Roads for assistance in determining the causes of the failures looking toward a solution of the problem. Mr. Miller's superiors decided that his background ideally fitted him for this assignment, and he was sent to Minnesota in the fall of 1919 for what was to have been an assignment for about 4 months, but which, as things developed, was to be for nearly 30 years. While it was early established that the cause of failures was presence in the subsoils of excess quantities of the sulfates of magnesium and sodium, there was, at the time, no known practical solution for the problem. Therefore, in 1920 an act of the Minnesota legislature appropriated funds for creation of a laboratory in which to work out a solution, if such were possible, with Mr. Miller in charge.

This work took many directions, and some of the tests ran for long periods of years. Rather early he determined the limits of concentrations of the soil sulfates that concrete drain tile, as then made, would tolerate. He also learned that dangerous concentrations were localized in limited areas, and he devised methods for sampling the ground water in order that the areas in question might be determined and mapped.

MOST IMPORTANT FACET OF MILLER'S FACT FINDING

Perhaps the most important facet of Mr. Miller's fact finding was the wide difference in sulfate resistance displayed by different portland cements on the market, as he showed this difference might be as great as 2,000 per cent. He was able to relate these differences to the chemical composition of the cements, particularly their content of the calculated compound tricalcium aluminate, almost regardless of all other factors that enter into cement manufacture. In one series of tests, lasting ten years, he determined the sulfate resistance of 122 cements from 82 mills. This series alone involved nearly 6,000 test cylinders. In 1922, he devised a method for rating the relative durability of test specimens by accurately measuring expansions due to the action of soil sulfates, and the method is now widely used for this purpose in many laboratories.

His work earned the respect and the co-operation of the portland cement industry, and of related agencies. Just recently one of the country's most eminent research chemists on cement, in referring to Mr. Miller, stated that his "work on the action of soil waters on concrete is the classical research in its field, and has served as a model for all future investigators." When he started these studies it was almost the universal tendency to look upon cement as just cement. Now there are standard specifications for five types, of which type V of the American Society for Testing Materials has an extremely high sulfate resistance. From the initial problem of drain tile and sulfates, Mr. Miller's studies eventually embraced such other influences as soil acids and silage juices. The striking improvements offered to and adopted by the makers of concrete stave silos brought about a veritable renaissance in that industry. In another direction the work of his laboratory appears in essential phases of the specifications for the cement used in the Fort Peck dam.

Indeed, the talent and perseverance of Dalton G. Miller play a part in every application of concrete which comes in contact with earth, as well as irrigation and other waters, sewage and other corrosive agents. While largely concerned with the character of the portland cement, his findings reach into other aspects of concrete technology. As an example, he was the first to demonstrate that concrete made with low-sulfate-resisting cements can be enhanced almost to the point of immunity by properly curing at temperatures of 212 to 350 degrees Fahrenheit.

Yet the immensity of his work with cement in the soil did not entirely preclude achievement in other aspects of drainage. Mention must be made of his major contribution to the studies underlying a report of the Minnesota Department of Conservation, titled "The Reaction of Swamp Forests to Drainage in Northern Minnesota." In that area, also, he directed ground water studies in the effort to extend knowledge regarding the water-storage capacities of marshes, and the effect of drainage on maintenance and stabilization of lake levels and stream flow.

Mr. Miller's reports are impressive both for their number and for the amount of research work they reflect, the trails they blaze, and the basic data they provide. A partial bibliography covering the last quarter century, consists of more than two score titles of published articles of which four appeared in the A.S.A.E. journal, AGRICULTURAL ENGINEERING, and the A.S.A.E. Transactions. Most of these are technical reports issued mainly by the University of Minnesota or other state agencies, and by the American Society for Testing Materials, though a diversity of other technical publications is well represented.

Mr. Miller became a member of the American Society of Agricultural Engineers in 1925. He is a member of the Minnesota Section of A.S.A.E. and represents it as a director on the board of the Minnesota Federation of Engineering Societies, with which the Minnesota Section is affiliated. He belongs to the American Concrete Institute and is a member of A.C.I. Committee 714 — Recommended Practice for the Construction of Concrete Silos. He is also a member of the Minnesota Academy of Science and the American Society for Testing Materials. In the latter he is a member of Committee C-1 on Cement, a member of C-15 on Manufactured Masonry Units, and is vice-chairman of C-4 on Clay Pipe. Besides his routine participation in A.S.A.E. activities and contributions to AGRICULTURAL ENGINEERING, Mr. Miller had a large part in working out the design for the present A.S.A.E. emblem.

The Miller family includes Mrs. Miller, the former Cecelia J. Grandratth of Iowa City, Iowa, and four children, Dalton Giles, Jr., Cecelia, Fredrick, and Curtis, all of St. Paul, Minnesota.

In his selection by the Jury of Awards, Mr. Miller is perhaps the subject of poetic justice. Whether by reason of reticence or of work too technical and specialized to arouse popular acclaim, he has occupied a paradoxical position. In the fact of professional eminence that approaches the spectacular he has maintained personal obscurity, comparatively speaking. Even those who thought themselves familiar with his work have been amazed at the magnitude of his attainments. One of these wrote:

"For approximately fifteen years Mr. Miller's work was carried on under my general supervision. While I always had a very high regard for the work he was doing, I did not fully realize the standing he had gained in his field until I made a trip with him to the National Bureau of Standards for consultation with engineers and chemists. The courtesy shown him and the attention given to his comments made it very evident that he was considered the authority in his field."

Roy Bainer — 1948 McCormick Medalist

(Continued from preceding page)

By sizing seed, using both measurement and gravity, he has been able to make improvements in plate planters, leading to what is known as precision planting. In this work he introduced the smooth-tube drop from the plate, and has been able to obtain highly accurate distribution of seeds whether segmented, decorticated, pelleted, or merely sized by screening. This basic work has led to planting experiments with various types of vegetable seeds such as the direct seeding of tomato, brocolli, onion, spinach, and others.

Hard on the heels of these developments, Mr. Bainer and his associates, as well as other agencies and interests, have been progressing steadily in perfecting means to mechanize the topping and harvesting of beets. By his personal genius and perseverance, by his inspiration and direction of others, he has played a major role in transforming beet culture from one of the most laborious to one of the most highly mechanized segments of agriculture.

His work has attracted world-wide attention. Visitors have come to his laboratory from every nation of Europe, from many of the South American countries, and also from the Orient. In 1945 the Ministry of Agriculture of Great Britain requested the University for the loan of Mr. Bainer for three months, "to obtain the benefit of the United States expert knowledge on the mechanization . . . . . of sugar beets and particularly on the segmenting of sugar beet seed . . . . the most useful man would be Professor Roy Bainer of your University, and they would very much like him to make the visit if that could be arranged."

Professor Bainer spent 3 months in England and is keeping in touch with the sugar beet seed development work there which was initiated as a result of his visit.

These references indicate the character of Mr. Bainer's engineering achievements. They do not cover the entire scope of his activities. Other studies in which he has engaged include the crusher-mower and dehydration methods for hay, vetch harvesters, stationary spray methods, pre-emergence spraying for weed control, castor bean threshing, and bulk handling of grain. He was a collaborator in creating the international combustion nut cracker, which literally blasts the shells from English walnuts without marring the meats.

Never a prolific writer, Professor Bainer has made notable contributions to the literature of his profession, principally in official college publications of Kansas and California, in professional journals, and in related trade and farm papers. Here, too, his capacity for cooperation is manifest. In a bibliography wherein the name Bainer appears 37 times, other names as collaborators appear 18 times. Of these 37 references, nine were to articles in AGRICULTURAL ENGINEERING.

Roy Bainer has been a member of the American Society of Agricultural Engineers since 1927, and he is currently chairman of the Society's Pacific Coast Section. He also holds membership in the American Society of Sugar Beet Technologists, the American Society of Engineering Education, and the honor societies of Sigma Xi, Sigma Tau, Gamma Sigma Delta, and Phi Mu Alpha. He is a past-president of the Rotary Club, Faculty Club, and of the Chamber of Commerce of Davis (California) and has been a trustee and elder in its Community Church. He and his wife (Lena May Cook) are parents of a daughter, La Nelle.

Profession-Wide Engineering

(Continued from page 287)

Providing a profession-wide technical forum for industries using agricultural engineers has become an important function of the American Society of Agricultural Engineers, with its meetings and publications. It has served to help the manufacturers of tractors, plows, combines, electrical equipment, structural materials, and soil and water conservation equipment, to provide improved products for farm use. It has also helped show the way to sound and satisfying utilization of their products.

With the help of some well-known agricultural engineers, the National Sprayer and Duster Association recently invited profession-wide consideration of some of its technology and problems. It addressed to agricultural engineers a letter outlining, in terms of critical equipment components, the status of its new major problem — weed control spray equipment.

The Association is to be congratulated on reaching the stage for profession-wide engineering, and on recognizing the fact. From the experience of other manufacturers, it can expect to be well repaid for identifying its place and problems in agricultural engineering technology. It will be repaid not only in good will and an attitude of friendly cooperation, but by increased agricultural engineering attention to the solution of some of its specific problems.

Some other farm-serving industries, or special product branches of the farm equipment industry, which are not already using profession-wide engineering, may be ready for it. The way in which their engineering may be given a broader foundation is clearly open.

RESEARCH NOTES

A.S.A.E. members and friends are invited to supply, for publication under this heading, brief news notes and reports on research activities of special agricultural engineering interest, whether of federal or state agencies or of manufacturing and service organizations. This may include announcements of new projects, concise progress reports giving new and timely data, etc. Address: Editor, AGRICULTURAL ENGINEERING, St. Joseph, Mich.

USDA Notes on Crop Conditioning Equipment, Sweet Potato Storage, Pea Aphid Control, Washington News, Dust Distribution, Chemical Drying, Radioactive Phosphorus, and Farm Implements

By JANE TUTTRUP

OVER 50 representatives of industry accepted the invitation of the USDA Bureau of Plant Industry, Soils, and Agricultural Engineering to the crop conditioning equipment conference held in Washington and Beltsville May 17 and 18. A like number of federal and state agricultural engineers and cooperating specialists also participated. Most of the papers presented at the conference are included in a mimeographed report of proceedings to be sent later to registered conferees. A limited number of copies will be available early in July from the BPISAE Divisions of Agricultural Engineering, Agricultural Research Center, Beltsville, Md.

E. A. Meyer, administrator of the Research and Marketing Act, presented at the first session some of the key ideas that governed the detailed research progress reports and discussion of specific problems for various commodities making up the bulk of the conference. He pointed out that scientific production and harvesting of crops have moved much faster than has conditioning for market. The full benefit of a farmer's efforts in growing and harvesting cannot be realized if he cannot properly condition his crop for storage, transportation, and other steps in the marketing process.

Not all farm crops, Mr. Meyer indicated, can or should move directly to market for conditioning. Terminal facilities cannot handle most crops as fast as they can be harvested by modern machinery. A glut of farm crops on the market is price depressing, especially when the crops come to market out of condition. Proper conditioning of crops right on the farm would do away with one of our big marketing problems—industrial utilization of damaged and inferior grades of food and feed grains.

"Farmers in many areas," said Mr. Meyer, "are of the opinion that safe, dependable conditioning of crops means conditioning by artificial means. They are asking for inexpensive—perhaps all-purpose—driers that can be individually owned, or perhaps owned by a small group of farmers. In any event, they want reliable conditioning equipment readily available when the need arises. Smart farmers see good conditioning as the first step in the marketing of their crops."

At the afternoon session on May 17, J. R. Allgyer, assistant to Mr. Meyer, reported that almost all of the commodity advisory committees working on field crops named crop conditioning and storage as among the problems facing their industry. Although each of the committees has a slightly different problem, there are many comparable elements. Crop conditioning research recommendations have been received from the advisory committees on grains, feeds, seeds, rice, soybeans and flaxseed, cotton and cottonseed, dry beans and peas, tobacco, and peanuts.

After presenting briefly the major recommendations for each of these commodities, Mr. Allgyer concluded by saying that the whole problem of up-to-date storage which takes into account the proper conditioning of all the important grain, feed, seed, oil, and forage crops, is wide open. "If we are to meet this challenge," he warned, "we will promptly and aggressively unite our forces to solve this problem in an intelligent and constructive fashion. The present is already late."

Sweet Potato Storage. The engineering problems stemming from the requirements of sweet potato curing and storage are how to maintain high enough relative humidity without deterioration of the structure and how to get adequate, controlled heat most economically. Attacking these problems, the USDA division of farm buildings and rural housing in cooperation with the University of Georgia has been running tests on six experimental houses, each of which holds 60 bu of sweet potatoes.

Of frame, aluminum, or cinder block construction with various kinds and amounts of insulation, the houses are heated electrically with strip heaters or soil-heating cable, thermostatically controlled. Bright-surface roll roofing or aluminum paint over a cement wash applied on the house interiors provides an effective vaporseal and helps maintain the high relative humidity while preventing condensation of moisture in the insulation.

The 60-bu size is considered to be minimum for building and heating an individual building economically. Furthermore, many farmers have just about 60 bushels of sweet potatoes to store. Although the construction and heating cost per bushel is higher than in larger houses, these structures built especially for the purpose are practical for curing and storing small lots of high-quality sweet potatoes for home use or for seed stock. During a normal season, the roots can be cured and stored for 4½ to 5 months in a well-insulated, 60-bu storage, located in climates similar to that at Athens, Ga., at an electrical energy consumption of about 4 kw-hr per bu.

Ventilation of small storages properly protected against damage by moisture should not be necessary under farm conditions except during excessively warm weather. Results obtained in the 60-bu houses can be applied to larger farm-type storages, with a saving per bushel in energy consumption, except that ventilators might be needed.

J. W. Simons is the USDA engineer in charge of the sweet potato storage investigations. Since last fall he has been assisted by Lloyd L. Smith, who graduated in agricultural engineering from the University of Georgia after work at Iowa State College and Army service in the South Pacific. An illustrated article on the project is included in the annual report on research and investigational activities, college of agriculture, University of Georgia, for the fiscal year ending June 30, 1947. In cooperation with J. M. Lutz of the BPISAE division of fruit and vegetable crops and diseases, Simons has recently revised Farmers Bulletin 1442, "Storage of Sweet Potatoes".

Pea Aphid Control. More effective control of the pea aphid is the first objective under the Research and Marketing Act project to develop and improve equipment and formulations for effective application of insecticides and fungicides. Responsibility for the new work is shared by the Bureau of Entomology and Plant Quarantine and the Bureau of Plant Industry, Soils, and Agricultural Engineering.

Experiments by the former bureau have shown that the pea aphid, one of the most destructive pests of legumes throughout the country, can be controlled by the timely application of various insecticides, such as formulations containing rotenone, or DDT. Effective control depends upon the timeliness, thoroughness, and rapidity of the application. Eighty thousand acres of canning peas are now grown in eastern Washington and Oregon, and for such large acreages a machine that can apply insecticides rapidly and effectively is a basic requirement.

Fundamental studies will be centered at the Pest and Plant Disease Control Machinery Laboratory at Toledo, Ohio, of which Frank Irons is the USDA agricultural engineer in charge. Airplanes will be tested with specially constructed spray booms and nozzles for applying concentrated sprays. Dust mixtures will be applied with special equipment mounted on ground machines.

Field work on a limited scale is being initiated in Oregon and will include territory in Washington and Idaho, with the experiment stations of the three states cooperating. Plans are to test air equipment and spray formulations on peas, alfalfa, and other legumes at different rates of speed and elevation and under varying conditions of wind velocity, temperature, and humidity.

Entomological phases of these field investigations with headquarters at Forest Grove, Ore., will be direceted by J. C. Chamberlin of the Bureau of Entomology and Plant Quarantine. Assigned to direct the engineering phases is USDA Agricultural Engineer Vilas D. Young, who has recently transferred to the Division of Farm Machinery from the Soil Conservation Service. A native of Montana, his agricultural engineering degrees are from Wisconsin and Oregon.

Washington News. Members and guests of the Washington (D.C.) Section of the American Society of Agricultural Engineers had an opportunity to examine some of the agricultural engineering research equipment at the Agricultural Research Center, Beltsville, Md., following the final luncheon meeting of the year at Log Lodge, June 11. J. R. McCalmont, retiring vice-chairman, was program chairman. At the engineering laboratory Wallace Ashby talked informally on the first Research and Marketing Act project, emergency development of corn drying equipment for farm use, showing a movie of the 1947-48 ear corn drying operations and some of the related laboratory work at Ames, Iowa.

At North Laboratory, Lowell E. Campbell showed the group the Division of Farm Electrification's ultrasonorator, a four-frequency instrument for generating supersonic energy. Radio-frequency energy is transmitted from a quartz crystal through a liquid bath to biological material in a test tube. Among the possibilities the Division wants to explore are increasing the rate and speed of seed germination and increasing crop yield through what is thought to be a rearrangement of the chromosome pattern in the plant genes. Subjecting eggs to supersonic energy may increase the keeping qualities and may be a means of controlling poultry diseases transmitted through the egg. Preliminary research by other workers indicates that the high-frequency vibrations can kill spores and soften the curd in milk.

Walter H. Redit, ASAE member with the Division of Fruit and Vegetable Crops and Diseases, then explained an exhibit of thermostatically controlled alcohol and charcoal heaters for refrigerator cars being tested in cooperation with the Association of American Railroads at the request of the Interstate Commerce Commission. The heaters are designed to provide automatic protection against freezing in transit.

Proceeding to the poultry investigations area of the research farm, the ASAE group saw the two 10-hen calorimeters built and equipped

to study the effects of temperature and other housing factors upon health, growth, and production. J. R. McCalmont and J. R. Vincent demonstrated the intricate testing and control apparatus of the project. L. G. Schoenleber then showed the group the installation of bactericidal lamps in the underground poultry house across the road. Two air filters with forced circulation have been added to reduce the dust concentration so that the bactericidal radiation will be more effective.

Research Administrator Resigns. Secretary of Agriculture Charles F. Brannan has announced the resignation of W. V. Lambert as administrator of the Agricultural Research Administration. Dr. Lambert leaves USDA to become dean of the school of agriculture and director of the agricultural experiment station at the University of Nebraska. He will assume his new duties October 1.

Born in Stella, Neb., in 1897, Dr. Lambert received his B.S. from the University of Nebraska, his M.S. from Kansas State College, and his Ph. D. from the University of California. From 1936 to 1940 he was in charge of USDA animal genetics investigations. In 1940 he left to become associate director of the Purdue Agricultural Experiment Station, returning in 1945 as assistant administrator of the Agricultural Research Administration. He was made administrator in October, 1946.

Dr. Lambert was a member of the Board of Alternates of the President's Scientific Research Board, is a member of the Government's Interdepartmental Committee on Science, and a member of the Mexican-United States Agricultural Commission. He was a member of the U. S. Delegation to the Food and Agriculture Organization of the United Nations at Copenhagen in 1946 and again at the Geneva conference in 1947. The successor of Dr. Lambert as administrator of ARA has not been announced.

Dust Distribution. Crop dusting by airplane presents the problem of feeding to the distributing mechanisms the greatly increased volume of dust needed in each second of operation. The "flow" must be steady and evenly adjusted or the dusting will be spotty and ineffective. This is one problem on which engineers are working at the USDA Pest and Plant Disease Control Machinery Laboratory at Toledo, Ohio. O. K. Hedden of the laboratory staff cites figures to show the difference in this one feature of equipment design as developed in experiments with dusting to control the corn borer.

"A ground duster," says Hedden, "traveling 5 mph, applying 20 lb of dust to the acre in a swath 28 ft wide, covers 0.28 acre a minute, and so must distribute 5.60 lb of dust a minute. If the airplane travels 60 mph, covers a swath of 35 ft, and applies 20 lb of dust an acre, its equipment must treat 4.24 acres a minute with 84.80 lb of dust. Speeding up to 85 mph, it must feed and disperse 120.2 lb of dust over 6.01 acres in a minute, or the dust must be handled at 2 lb every second—21.46 times as fast as in the ground machine."

Accurate measurement of the performance of an aerial duster has been hindered by lack of a practical technique. The laboratory staff has recently developed a new test technique with dyed dust for color determinations of deposit. This method provides a means of evaluating performance in the airplane dusting equipment developments accurately and in a relatively short time.

Chemical Drying. The calcium chloride dryer for blue lupine seed worked out in the laboratory by J. W. Simons at the college of agriculture, Athens, Ga., has been built to field size and tested during the lupine harvest the end of May in the storage house of H. G. Harrison, Sandersville, Ga. The dryer has been redesigned with the seed bin separate from the calcium chloride chamber and the V-flake trays running parallel to the direction of air flow.

Some of Mr. Harrison's seed was dried with an All-Crop drier so that comparisons could be made of the relative efficiency of calcium chloride and heated air drying. Data from the two series of test runs are being compiled.

Radioactive Phosphorus. G. A. Cumings and his staff at the agricultural engineering laboratory, Beltsville, Md., have recently developed fertilizer distribution machines with special safety factors for use with the new and powerful plant research material, radioactive phosphorus. There is every indication that the use of radioactive elements will make possible a rapid advance in the solution of both new and old problems of crop production and soil research. The Soils Division, BPISAE, is cooperating with state agricultural experiment stations in several studies using radioactive isotopes to determine how much of the phosphorus utilized by plants is derived from applied fertilizers and how much comes from the original soil supply of the element.

One machine made at the fertilizer distribution machinery shop is for work with sugar beets and alfalfa in Colorado. It is equipped with two tubes and spreading cones for broadcasting fertilizer over a strip 20 in wide. Another machine is for North Carolina experiments on cotton, corn, tobacco, and potatoes. It distributes over a 36-in band. Both have the endless-belt-type hopper with plexiglass sides and top. The plexiglass, ½-in thick, permits visibility for checking the even distribution of the radioactive material along the belt while screening out its rays and so protecting workers from exposure.

Setting Farm Implements. William E. Meek and Battle B. Ewing, agricultural engineers of the Farm Machinery Division on the staff of the Delta Branch Experiment Station, Stoneville, Miss, are authors of Circular 138, "Line-Diagram Method for the Setting of Farm Implements", just issued by the Mississippi station. The circular presents a technique of painting a diagram on the floor of the farm shop or other level surface so that machines can be almost completely set and adjusted before being taken to the fields. In developing this method the authors had the assistance of E. Buford Williamson, Warren R. Wortman, and other members of the Stoneville staff. The idea has become quite popular with Delta farmers and issuance of the circular is in response to heavy demand.

"For many years," the authors explain, "both implement men and farmers have thought that machines had to be set and adjusted in the fields where they were to be used. This method makes it extremely difficult to obtain as accurate a setting as is desirable with modern farming methods using the high speeds available."

The line diagram consists of a center line for aligning the tractor and shorter lines representing the rows and the middles. When the tractor, with the implements mounted, is in proper position on the diagram, the ground-working tools can be seen clearly in position with their relation to both the row and the middle. By bringing to light sprung or bent parts, the diagram serves as a periodic check on the condition of the implements.

Practically all row-crop implements, such as middlebreakers, planters, and cultivators can be set and adjusted on the line diagram, some completely and some for row width only. Tractor wheel spacing can be quickly and accurately checked.

New Literature

THE SQUIRES CAN TAKE IT, by Ladd Haystead. Cloth, 240 pages, 5½ x 8 inches. Pellegrini and Cudahy (New York 3, N.Y.) $3.50.

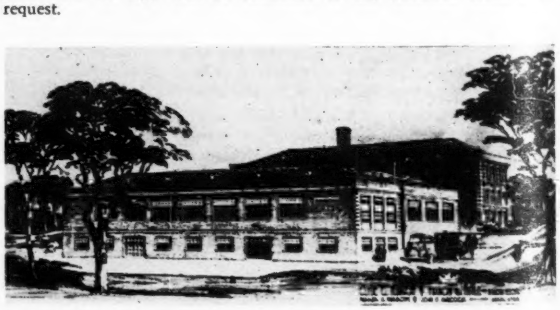
Squire Haystead grooms and shows with almost paternal pride that increasingly prevalent hybrid, the non-farmer owner of farm land. He nurtures the delicate humor of red-ink farm accounting with the solicitous touch of a gardener weeding a row of bean sprouts. He reflects satisfaction with this agrarian hybrid as a phenomenon, without belaboring him to serve the tonnage market ahead of the good life. In fact, we arrive at the back cover terminus of his personally conducted tour with the impression that, where the genial good nature, tolerance, and neighborly characteristics of the hybrid are dominant, he will prove a valuable legume in the human crop rotation.

SOIL PHYSICS, by L. D. Baver. Second edition. Cloth, xiii + 398 pages, 6 x 9 inches. Illustrated and indexed. John Wiley and Sons, (New York). $4.75.

Second edition additions include new information on the shape of soil particles, as revealed by the electron miscroscope, soil-moisture relationships, soil structure, aeration, plowing, and effect of raindrops on soil erosion. The whole subject is handled under ten subject headings covering the introduction, mechanical composition of soils, physical characteristics of soil colloids, soil consistency, soil structure, soil water, soil air, soil temperature, physical properties of soils and tillage, and physical properties of soils in relation to runoff and erosion.

SUGGESTIONS ON OVERCOMING CONSTRUCTION DEFECTS AND OTHER FACTORS THAT CAUSE PAINT FAILURES ON WOOD SURFACES, by Henry A. Gardner. Circular 723, (revision of Circular 428) Scientific Section, National Paint, Varnish, and Lacquer Association, Inc. (Washington, D.C.).

A 32-page, 6 x 9-inch pamphlet of practical information on improvement of wood surface conditions and use of primers to increase paint life. A copy will be furnished to any A.S.A.E. member on request.



This picture is a reproduction of the architect's drawing of the new annex to the present agricultural engineering building of the Alabama Polytechnic Institute, which will provide 20,000 additional square feet of floor space, and in addition to being a farm machinery laboratory, will include a dairy engineering laboratory and wood shop. The appropriation for this facility was made by the Alabama state legislature, and the project was sponsored by the Alabama Farm Equipment Association, of which J. B. Wilson, state extension agricultural engineer, is secretary. It is expected the department will occupy the new quarters by January

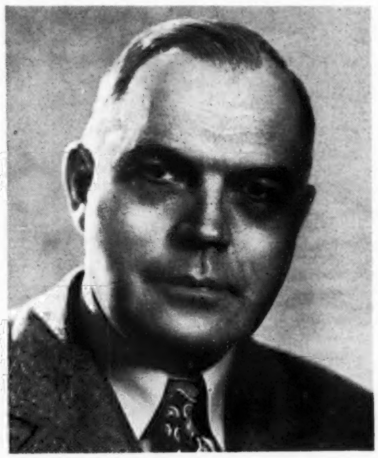
NEWS SECTION

Schwantes Takes Office as the New ASAE President

ARTHUR J. SCHWANTES became president of the American Society of Agricultural Engineers June 23 in a brief ceremony during the annual dinner of the Society at Portland, Ore. Retiring president George A. Rietz presented the official gavel, with which Mr. Schwantes became the forty-second president of the Society.

Mr. Schwantes has been an active member of the Society since 1922, and was elected to the grade of Fellow in 1938.

A native of Wisconsin, he studied agricultural engineering at the University of Wisconsin from 1915 to 1917, then went into commercial work in the land-clearing equipment field, left this for army service during World War I, returned to it for a brief period, and in 1921 went to the University of Minnesota. There he served as assistant professor in land clearing while completing requirements for his bachelor's



ARTHUR J. SCHWANTES

degree in agriculture, majoring in agricultural engineering. He was awarded this degree in 1925.

With further study as time permitted he earned a master's degree in agricultural engineering from the University of Wisconsin in 1930.

During his early years at the University of Minnesota he was responsible for research in costs and methods of land clearing, and for extension work in this field, including distribution of salvaged war explosives and training farmers in their use.

In 1927 Mr. Schwantes was made head of the farm power and machinery section in the University's division of agricultural engineering. From this position he progressed in 1930 to become acting chief of the division of agricultural engineering, and in less than a year he was named chief of the division. Under his administration since that time it has continued to develop and contribute to the general progress of agricultural engineering.

His special technical interest is the management and use of farm power and machinery. He still teaches a graduate course in this field.

The new A.S.A.E. president has practiced and encouraged a policy of close relationship with the industries providing engineered products for farm use, and is a member of the Northwest Farm Equipment Association.

He is also a member of the Engineers Club of Minneapolis, The Minnesota Academy of Science, the American Association for the Advancement of Science, and the American Society for Engineering Education.

In the American Society of Agricultural Engineers he has just completed a term as chairman of the College Division, and is a former chairman of the Power and Machinery Division and of the Minnesota Section. In addition he has served on various committees as member and chairman, has appeared on professional and technical programs at meetings of the Society, and is the author of numerous papers and reports incidental to his technical and administrative work.

A.S.A.E. Meetings Calendar

September 8-10 — NORTH ATLANTIC SECTION, Ontario Agricultural College, Guelph, Ont., Canada.

October 21 and 22 — PACIFIC NORTHWEST SECTION, Columbia Gorge Hotel, Hood River, Ore.

December 13-15 — WINTER MEETING, Stevens Hotel, Chicago.

June 20 to 23 — ANNUAL MEETING, Michigan State College, East Lansing, Mich.

ASAE Portland Meeting Huge Success

FROM practically any point of view the 41st annual meeting of the American Society of Agricultural Engineers held last month at Portland, Oregon, was outstanding. The efforts of speakers, Meetings Committee, and Committee on Local Arrangements combined to give it top rank with past meetings. While the attendance was not as high as at some previous meetings, considering the distance from the center of ASAE membership, the attendance was larger than could reasonably be expected. Registrations reached the 300 mark, and in addition there were more than 100 women and children who came with ASAE members from all parts of the country, mostly traveling by automobile.

Apparently the flood conditions that prevailed for some weeks in the vicinity of Portland, and which were greatly exaggerated in many respects, had no appreciable effect in keeping persons from attending the meeting.

The trek of ASAE members and their families began to descend on Portland on Saturday, June 19, and by Sunday afternoon there were around 200 arrivals. Activity at the registration desk was in full swing Sunday afternoon and evening. Sunday evening entertainment included an interesting sound motion picture on the snow survey work of the Soil Conservation Service and a talk by a colonel of the U. S. Army on the recent flood in the Columbia River Valley.

The portion of the program devoted to papers and addresses opened Monday, June 21, with five concurrent programs during the forenoon sponsored by the Power and Machinery, Rural Electric, Farm Structures and Soil and Water Divisions of the Society, and a special program arranged for the forty or more members of ASAE student branches who attended the meeting.

The first general session of the meeting was called to order at 2:00 p.m. on Monday by Clyde Walker, chairman of the Committee on Local Arrangements. Ivan D. Wood, chairman of the Meetings Committee, was introduced and gave a brief preview of the program for the three days, following which Mr. Walker introduced the President of the Society, George A. Rietz, manager, farm industry division, General Electric Company, who delivered the President's annual address, published elsewhere in this issue. Mr. Rietz was followed by an address by H. B. Walker, professor of agricultural engineering, University of California, in which he gave an interesting and dramatic resume of sixteen years of sugar beet machinery research in this country.

Following a short recess the meeting was again called to order by President Rietz for the annual business session of the Society, at which a resume of the annual report of the Secretary-Treasurer and reports of several committees and ASAE representatives to other organizations were presented.

During the early evening of June 21, the visiting students and advisors of ASAE student branches were entertained with a complimentary dinner by the International Harvester Company, which has been a regular feature of ASAE annual meetings for the past 12 years.

Three concurrent programs occupied Monday evening and included an outstanding program arranged by the Committee on Extension, a rural electrification round table arranged by the Rural Electric Division, and a series of movies showing the development and application of specialized machines for western agriculture sponsored by the Power and Machinery Divisions, with J. P. Fairbank as master of ceremonies.

The forenoon of Tuesday, June 22, was devoted to six concurrent programs including those sponsored by the Power and Machinery, Rural Electric, Farm Structures, Soil and Water, and College Divisions, and the special student group program.

Tuesday afternoon was given over to a most interesting and pleasurable trip to Timberline Lodge on the lap of Mount Hood, including an entertaining trip for most of the group on the ski lift at the Lodge. The return trip to Portland was pleasantly interrupted during the early evening with a salmon barbecue along the way, at which some 425 people consumed about 250 pounds of salmon barbecued to the queen's taste under the able supervision of H. B. (Herb) Howell, superintend-

ent of the J. J. Astor Branch of the Oregon Agricultural Experiment Station at Astoria.

The programs sponsored by the Society's technical divisions were completed Wednesday forenoon, June 23, with a program of the Power and Machinery Division, Farm Structures Division, and a joint program by the Soil and Water and Rural Electric Divisions. Concurrently with these programs the student group held their concluding session, electing the following officers of the National Council of ASAE Student Branches for the ensuing year: President, Thomas E. Clague, Iowa State College; First Vice-President, Lawrence W. Larsen, University of Idaho; Second Vice-President, Robert C. Evans, Ohio State University; and Secretary, Norman A. Flaten, University of Saskatchewan.

The second and concluding general session of the meeting was held on Wednesday afternoon with three addresses, one on rural electrification development in the Pacific Northwest by L. J. Smith, state professor of agricultural engineering, State College of Washington, another on the challenge of irrigation to agricultural engineers, by F. Earl Price, acting dean of agriculture, Oregon State College, and the third by Alfred D. Edgar, USDA agricultural engineer on agricultural engineering problems in Alaska.

The climax of the meeting, as usual, occurred with the ASAE Annual Dinner held during the evening of Wednesday, June 23. Ivan D. Wood, engineer, Soil Conservation Service, USDA, presided as master of ceremonies at the dinner. Following the presentation of awards of honor by President George A. Rietz, which included the award of the John Deere medal to Dalton G. Miller, the Cyrus Hall McCormick medal to Roy Bainer, and the five 1947 ASAE Paper Awards to Roy Bainer, W. D. Ellison, Arthur W. Clyde, R. A. Glaze, and R. J. McCall, and the Farm Equipment Institute Trophy to the Iowa Student Branch of ASAE, Mr. Wood introduced Mr. E. B. MacNaughton, chairman of the board of the First National Bank of Portland, who addressed the group on the economic opportunities in the Pacific Northwest.

The dinner program was concluded with the inauguration by retiring President Rietz of the new president of the Society for the 1948-49 year, Arthur J. Schwantes, head, agricultural engineering division, University of Minnesota. Mr. Schwantes, as his first duty as president of the Society, awarded Mr. Rietz the ASAE past-president emblem which consists of a gold emblem on a white ground with a gold bar through the center with the word "Past-President."

Garver Heads Washington Section

AT ITS meeting on June 11, the Washington (D.C.) Section of the American Society of Agricultural Engineers completed a series of ten interesting and successful meetings with an average attendance of 60 persons. For the next series of luncheon meetings beginning in September, the Section elected as its new chairman, Harry L. Garver, agricultural engineer (BPISAE), U. S. Department of Agriculture. The new vice-chairman of the Section is Barton C. Reynolds, agricultural engineer, USDA Office of Experiment Stations, and the new secretary-treasurer is Guy W. Gienger, extension agricultural engineer, University of Maryland.

Kummer New A-E Head at API

EFFECTIVE July 1, F. A. Kummer, agricultural engineer, Alabama Agricultural Experiment Station, officially became head of the department of agricultural engineering of the school of agriculture and the agricultural experiment station of the Alabama Polytechnic Institute, succeeding J. H. Neal.

Refrigeration Publications Available

THE American Society of Agricultural Engineers has an exchange arrangement with the American Society of Refrigerating Engineers which offers the members of one society the privileges of purchasing any or all of the publications of the other at the regular membership rates of that society.

The A.S.R.E. offers the A.S.A.E. members the following publications at the membership rates indicated:

Refrigerating Engineering, monthly magazine and official publication of the A.S.R.E., completely covers every aspect of refrigeration and air conditioning. It is the most reliable source for comprehensive, impartial information about the latest, proved scientific solutions to refrigeration problems and air conditioning of all kinds. The annual subscription price is $3.00 in the U.S., $4.00 elsewhere. The membership rate is $2.50 in the U.S., $3.50 elsewhere.

Refrigeration Abstracts, a new publication containing brief condensations of all articles of refrigerative interest appearing in hundreds of periodicals and reports published internationally on refrigeration and allied subjects. It is issued five times a year and subscriptions can be predated to start with the first issue published in January, 1946. The annual subscription price is $7.00 in the U.S., $8.00 elsewhere. The membership rate is $5.00 in the U.S., $6.00 elsewhere.

REFRIGERATION DATA BOOK.

The Applications Volume of this data book contains up-to-date and authoritative information on all applications of refrigeration and air conditioning — data that will facilitate your work and keep you informed of all the latest developments in the industry. The second edition was published in 1946 and sells for $5.00 a copy in the U.S., $5.50 elsewhere. The membership rate is $3.00 a copy in the U.S., $3.50 elsewhere.

The Basic Volume of this data book is the standard illustrated reference work of the refrigeration and air-conditioning industry. It contains theoretical explanation of the principles of refrigeration and air conditioning with unique analyses, examples, tables and charts, problems and their solutions. The fifth edition (1942) is now in its fourth printing. A limited run will be available on July 1, 1947, to sell for $4.00 a copy, while it lasts. A new sixth edition is now in preparation but will not be released until 1948. The membership price on the old book is $2.50 in U.S., $3.00 elsewhere.

Descriptive folders on the above-named publications of the American Society of Refrigerating Engineers will be mailed on request. Orders must be on a strictly cash basis to make it possible to offer the A.S.R.E. publications at such low prices. Orders for the above publications should be sent direct to the A.S.R.E., 40 West 40th Street, New York 18, N. Y.

Dearborn Motors Shows Expanded Line

MORE than 60 implements of the Dearborn line, and the new Ford tractor, were shown June 16 to several hundred representatives of the press, radio, and farm organizations. The demonstration was held at Deer Lake Hills Farm, Clarkston, Mich.

In opening the program Walter Murphy, manager of press and radio relations, extended the greetings of the hosts. G. D. Andrews, manager of advertising and sales promotion, explained the purpose of the demonstration.

Frank R. Pierce, president of Dearborn Motors Corp., introduced several Ford Motor Co. directors who were present, and outlined briefly the progress and plans of the Dearborn organization.

David Meeker, director of education, served as ringmaster in directing a combined parade of all the implements shown and demonstrations by groups including the Ford tractor, special-duty implements, soil-breaking implements, seedbed preparation implements, planters, cultivators, haying implements, harvesting equipment, earth and snow-moving equipment, and hard job specialists.

Following the demonstration visitors were given the opportunity to inspect the equipment at close range. A luncheon and social period concluded the program.

Georgia Irrigation Developments Filmed

IRRIGATION developments in Georgia were recently the subject of professional filming by RKO Pathe Studios for the Texas Company. With technical supervision by E. H. Davis, agricultural engineer, Georgia Agricultural Extension Service, the studio photographers filmed irrigation operations on two private farms in the state.

On one farm the star performer was an installation for the simultaneous application of irrigation water and fertilizer to 40 acres of corn or other field crops. The other robot actor was a long-range sprinkler head discharging 500 gpm at 100 psi, in a circle of 200-ft radius, in the above-tree irrigation of peaches. With this range and capacity it can irrigate three acres, or more than 200 trees from one setting.

These Georgia irrigation developments, along with fourteen other farm subjects, were selected for filming by the farm board of the Texas Company from a preliminary list of 300 newsworthy farm projects.

A long-range sprinkler head discharging water at 500 gpm at a pressure of 100 psi in a circle of 200-ft radius


OLIVER
BEGINS
Its Second
Century
66
77
88
OLIVER
SALES
SERVICE

NEWS SECTION

(Continued from page 318)

"Tractors for India"

TO THE EDITOR:

I SHOULD like to comment on what Mr. Dwarka Dass J. Bhatia has said about agricultural engineers appointed by the various provincial governments of India, in his letter under the above title on page 84 of AGRICULTURAL ENGINEERING for February. His impression is not something which is new, and just has been pinned on these officials. On the contrary, you will be surprised to know that these officers are doing magnificent and fruitful work, leading to new developments all over the country. A typical example is the reclamation of Ganges Kadder claimed to be the biggest project in the East, in which thousands of acres a month are being reclaimed with the help of tractors. This is to the credit of our central government officers.

All provincial governments have their own fleet of tractors, and the job of keeping these machines in order and operating them is done by the agricultural engineers in charge. One of the provincial governments has undertaken custom work to assist the farmers. Most of these governments have already placed large orders with leading firms and are awaiting the machinery which is coming from America and England. Unhappily Mr. Bhatia has been looking out of the window when government men are busy changing the phase of our agriculture. Notwithstanding the many uncertainties which lie ahead of us to complete the job, we are determined to turn the corner in the course of time.

As regards the ban on imports, referred to by Mr. Bhatia, our governments were strict, but they freely allowed all agricultural machines. I know that almost all the leading dealers got their licenses revalidated within a short time. Moreover, they had no difficulty in procuring the licenses. Believe me there is no truth in Mr. Bhatia's statement.

Referring to the concluding paragraph of Mr. Bhatia's letter in which he considers light and medium tractors of 5 to 20 hp as most suitable for Indian conditions, I would say that, if he had been a farmer and spent his life in this occupation in India and had had some experience in tractor farming, he would never have thought of these small tractors as satisfactory under Indian soil conditions. We need large tractors in India. Generally speaking, the soils of this country are extremely difficult to handle, and high power is required for cultivating them. In the United States the upper limit of soil resistance, to which wheel-type tractors can be used, is a drawbar pull of 7 lb per sq in. In the majority of soils in India, this drawbar pull amounts to as much as 21 lb per sq in. This alone is sufficient justification for our demand for larger tractors. From the little experience I have had in the past, I will say that the mere idea of light tractors is not at all a good proposition. Under the very heavy black cotton soil conditions over the whole of the central and peninsular India, it is impossible to use any small wheel-type tractor. For the eradication of deep-rooted weeds such as Kans (Sacharum Sp.) and harali (Cyanoden Sp.), these small-type tractors are absolutely useless; only track-type tractors will stand up to the job. By this I do not mean that we cannot use wheel-type tractors in India. Of course we can, but of a larger size.

Assistant Agricultural Engineer
Volkart Brothers, Calcutta

R. P. SAXENA

TO THE EDITOR:

I AM somewhat surprised that you have found space for the letter from Mr. Bhatia under the above title, on page 84 of AGRICULTURAL ENGINEERING for February, as it seems to me that it is so obviously a propaganda letter designed for personal advertising purposes. I do not know the firm in question, but I am acquainted with the larger dealers in India, and believe Mr. Bhatia's firm to be only some local dealer.

The Government of India has had to pursue a very careful policy about dollar exchange, and has had to severely restrict and ban the importation of other items. So far as I know, there has never been anything more than possibly a temporary ban on the importation of tractors, and I believe the policy of the Government of India has been quite generous in giving licenses for import of tractors of proven type. In fact, my impression is that they have gone considerably beyond what I would approve in issuing such licenses, and in encouraging the use of tractors. My impression is that established dealers have been able to get licenses for as many tractors as American manufacturers were in position to supply.

I would certainly disagree with Mr. Bhatia's ideas about the size of tractors suitable. There is still room for difference of opinion as to what size tractors should be imported, but small tractors are certainly being advertized in India far above what their performance justifies.

While it is true the Government of India and the provincial governments have not always been able to get men of the training and experience which they desired, I do not believe that the agricultural engineers deserve the scolding which Mr. Bhatia has administered. From the tone of his letter, I doubt whether he is competent to judge the matter.

MASON VAUGH

Agricultural Engineer
Allahabad Agricultural Institute
Allahabad, India

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Aeschliman, Harold E.—Farm power engineer, Toledo Edison Electric Co. (Mail) R. R. No. 3, Wauseon, Ohio.

Aldred, Fred L., Jr.—Student in agricultural engineering, University of Georgia. (Mail) Thompson, Ga.

Ayers, A. R.—Assistant in agricultural engineering extension, University of Illinois, Urbana, Ill.

Balk, William A.—Junior agricultural engineer, Sandhill Experiment Station. (Mail) R. R. No. 3, Columbia, S. C.

Bassett, Day L.—Agricultural engineer, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA. (Mail) Logan, Utah.

Beasley, Randall L.—Student in agricultural engineering, University of Illinois. (Mail) Irving, Ill.

Brown, Edwin G.—Engineer, Minneapolis-Honeywell Regulator Co. (Mail) 1919 K Street, N. W., Washington 6, D. C.

Bullard, Frank L., Jr.—Macon, Ga.

Christiansen, J. Y.—Graduate student in agricultural engineering, Utah State Agricultural College, Logan, Utah. (Mail) 54 North 2nd St., West.

Clark, John H.—A. Harold Clark & Son (farmers), Mountain, Ont., Canada.

Crist, Robert S.—Rural service representative, West Penn Power Co. (Mail) R.R. No. 1, Box 161, Jersey Shore, Pa.

Dahnert, Duane R.—Agricultural engineer, Illinois Northern Utilities Co. (Mail) 1200 Jefferson, Mendota, Ill.

Davis, Hollis R.—District agricultural engineer, Cornell University. (Mail) DeRuyter, N. Y.

Dean, Gregory W.—Distribution engineer, Consumers Power Co., 110 E. Michigan Ave., Lansing, Mich.

DeKramer, Ray H.—Irrigation engineer, Bureau of Reclamation, USDI. (Mail) 820 10th St., S. W., Huron, S. D.

Dunlap, W. M.—Special traveler, tillage and seeding machines, International Harvester Co. (Mail) 138 Merrill Ave., Decatur, Ga.

Dyer, Ephraim, Jr.—Salesman, Pioneer Equipment Corp. (Mail) 143 Tunnel Road, Berkeley 5, Calif.

Endahl, L. J.—R. R. No. 1, Wessington Springs, S. D.

Eubank, Thomas E.—Farm sales representative, Houston Lighting & Power Co., Houston, Tex. (Mail) 2139 Danville.

Ferguson, James E.—Graduate student in agricultural engineering, Utah State Agricultural College, Logan, Utah. (Mail) Quonset No. 30.

Fields, Robert D.—Territory supervisor, J. I. Case Co. (Mail) 360 W. Jefferson St., Syracuse, N. Y.

Fogel, Martin M.—Graduate student in agricultural engineering, University of Minnesota, Minneapolis, Minn. (Mail) 3558 Knox Ave., N.

Frantzreb, Walter G.—Agricultural engineer, Public Service Co. of Northern Illinois. (Mail) 22 W. Cass St., Joliet, Ill.

Funk, Henry N.—In training for partnership, Arthur Funk, building contractor, R. R. No. 1, Lebanon, Pa.

Garton, James E.—Student in agricultural engineering, Oklahoma A. & M. College, Stillwater, Okla. (Mail) Box 142, Vet Village.

Giles, J. Gordon—Salesman and estimator, Reynolds Bros. Lumber Co., Albany, Ga. (Mail) 207 S. Jefferson.

Goolsby, H. B.—Trainee, parts dept., J. I. Case Co. (Mail) 523 Stewart Ave., Atlanta, Ga.

Gregg, John E., Jr.—Irrigation engineer, Bureau of Reclamation, USDI. (Mail) 505 W. 5th St., Chico, Calif.

Gunnison, Samuel V.—Vice-president, W. R. Ames Co., 150 Hooper St., San Francisco, Calif.

Hakala, Reynold—Junior engineer, Lincoln Equipment Inc., 2226 University Ave., St. Paul, Minn.

Hall, Carl W.—Instructor in agricultural engineering, University of Delaware, Newark, Del.

Harris, Kenneth A.—Agricultural consultant, Wasilla, Alaska.

Helms, James O., Jr.—Student in agricultural engineering, Alabama Polytechnic Institute. (Mail) 521 N. Main, Enterprise, Ala.

Henderson, James G.—Student in agricultural engineering, University of Georgia. (Mail) Chamblee, Ga. *(Continued on page 324)*

Applicants for Membership

(Continued from page 322)

Hite, Homer R.—Design engineer, John Deere Van Brunt Co., Horicon, Wis.

Howeth, Don M.—W. W. Howeth Co., Box 496, Gainesville, Tex.

Husman, Delmar W.—U. S. Department of Agriculture. (Mail) 1013 W. Washington St., Champaign, Ill.

Ives, Freeland C.—Student in agricultural engineering, University of Illinois. (Mail) Wapella, Ill.

Johnston, D. W.—In charge of agricultural div., Hartzell Propeller Fan Co., Piqua, Ohio.

Keller, George V.—Pump irrigation engineer, Walter T. Dunlap & Co., Lexington, Neb. (Mail) 204 W. 6th St.

Kemp, E. H., Jr.—Farm training instructor, County Board of Education. (Mail) Acworth, Ga.

Kline, Cernyw K.—Student in agricultural engineering, Michigan State College, East Lansing, Mich. (Mail) 237 Valley Ct.

Klingelhofer, Karl R.—Student in agricultural engineering, University of Wisconsin. (Mail) R. R. No. 1, Sparland, Ill.

Kumar, Bir Sain—Supervisor, office of agricultural engineer, Government of East Punjab, Ambala City (East Punjab), INDIA. (Mail) c/o Mr. Atma Singh, 327 Mason Hall, East Lansing, Mich.

Land, William B.—Box 1018, Auburn, Ala.

Leech, Robert S.—Instructor in agricultural engineering, Purdue University, West Lafayette, Ind.

Leslie, Richard T.—Field instructor, education dept., Dearborn Motors Corp., 15050 Woodward Ave., Detroit 3, Mich.

Leuty, Craig R.—Division of agricultural engineering, Department of Agriculture, Fredricton, N. B. Canada. (Mail) 312 Northumberland St.

Liedtke, Stanley D.—Junior experimental engineer, John Deere Dubuque Tractor Works, Dubuque, Iowa. (Mail) 2078 Chaney Rd.

Livingston, Jack—Vice-president in charge of engineering and sales, Farm Improvement Co., 3523 Blake St., Denver 5, Colo.

MacMillan, D. W.—Assistant agricultural engineer (extension), Department of Agriculture, Morrisburg, Ont., Canada.

McNiel, Charles G.—Supervisor of harvesting machines sales, Dearborn Motors Corp. (Mail) 2023 Woodland Ave., Royal Oak, Mich.

Meeker, Thomas B.—Farm engineer, Meeker Dairy Farms, Britton, Okla. (Mail) Box 516.

Mitten, Horace L., Jr.—Student in agricultural engineering, Michigan State College, East Lansing, Mich. (Mail) 349 University Ave.

Moe, Dennis L.—Student in agricultural engineering, South Dakota State College, Brookings, S. D. (Mail) Box 737, College Station.

Musser, Earl C.—Engineering office, Allis-Chalmers Mfg. Co. (Mail) LaPorte, Ind.

Neeley, Joseph P.—Trainee, J. H. Neeley's Farm Garage, R. R. No. 5, Shelbyville, Tenn.

Newton, Paige—President and treasurer, Mitchell, Lewis & Staver, 801 S. E. Alder St., Portland 14, Ore.

Ota, Hajime—Research assistant in agricultural engineering, University of Minnesota, University Farm, St. Paul 1, Minn.

Pallmeyer, William C.—Assistant county agricultural agent, Meridian, Tex.

Parker, H. P.—Agricultural engineer, Soil Conservation Service, USDA. (Mail) P. O. Box 749, Great Bend, Kans.

Paul, S. K.—Supervisor, well-boring operations, The Agricultural Engineer to Government of East Punjab, India. (Mail) 304 Phillips Hall, Michigan State College, East Lansing, Mich.

Perry, J. W.—Farm sales representative, Houston Lighting & Power Co., Houston, Tex.

Pflug, Irving J.—R. R. No. 3, Oakland City, Ind.

Poss, Robert L.—Sales engineer, Lilliston Implement Co., Albany, Ga. (Mail) 1101½ N. Davis St.

Powers, C. Robert—Manager, procurement and engineering, Dearborn Motors Corp., 15050 Woodward Ave., Detroit 3, Mich.

Ramsour, Harold H.—Extension agricultural engineer, Kansas State College, Manhattan, Kans.

Reeves, William G., Jr.—Student trainee, J. I. Case Co. (Mail) 14 Wells St., Cartersville, Ga.

Reuter, Floyd W.—Trainee, engineering dept., Harry Ferguson, Inc., 3639 E. Milwaukee Ave., Detroit 11, Mich.

Rokeby, Thomas R. C.—Graduate student in rural sanitation, Ontario Agricultural College, Guelph, Ont., Canada.

Sandford, Raymond A.—1739 Fairview North, St. Paul, Minn.

Snyder, Stanford R.—Trainee in sales and service, A. B. Farquhar Co. (Mail) 629 N. 2nd St., Pottsville, Pa. *(Continued on page 326)*

Applicants for Membership

(Continued from page 324)

Stoeber, Leo O.—J. I. Case Co. (Mail) c/o Conrad Nitzel, Julesburg, Colo.

Strand, Vincent T.—Junior engineer (design), John Deere Des Moines Works. (Mail) Gowrie, Iowa.

Sulek, John J., Jr.—Student in agricultural engineering, Purdue University. (Mail) R. R. No. 3, Kewanna, Ind.

Summers, Neil W.—Design engineer, The Oliver Corp., South Bend, Ind.

Taff, Ernest T.— Agricultural engineer, Rome Plow Co., Cedartown, Ga.

Thomas, Henry J.—404 Florence Ave., Bloomington, Ill.

Thomas, James D.—Student engineer, Caterpillar Tractor Co. (Mail) 800 W. Washington St., Peoria 8, Ill.

Whitaker, James H.—Instructor in agricultural engineering, University of Connecticut, Storrs, Conn. (Mail) Box U 15.

White, James W.—Sales engineer, Beatty Bros., Ltd., Fergus, Ont., Canada.

Woods, Vernon G.—Junior agricultural engineer, cotton mechanization, Delta Experiment Station, Stoneville, Miss.

Wu, Dah Chang—Lecturer, Tsing Hua University, Peiping, China. (Mail) c/o E. W. Lehmann, University of Illinois, Urbana, Ill.

TRANSFER OF GRADE

Johnson, Edward A.—Hydrologist, Southeastern Forest Experiment Station, USDA. (Mail) Coweeta Experiment Forest, R. F. D., Dillard, Ga. (Junior Member to Member)

Trapp, D. L.—Lecturer in agricultural engineering, University of Saskatchewan, Saskatoon, Sask., Canada. (Mail) 619 7th St. (Junior Member to Member)

New Federal and State Bulletins

Building and Remodeling Dairy Barns, by Edward W. Foss. Maine Extension Bulletin 369 (Orono, February, 1948). Practical advice for dairy farmers with barn problems. The same or similar bulletins have been made available by the agricultural extension services of each of the New England States.

Annual Report (1947), Mills County, Iowa, Soil Conservation District. Malvern, Iowa. A neat summary of accomplishments and work in sight in one soil conservation district.

Electric Water Systems for Farms, by Jesse B. Brooks. Kentucky Extension Circular 452 (January, 1948) (Lexington). Practical information on water supply and water system installations.

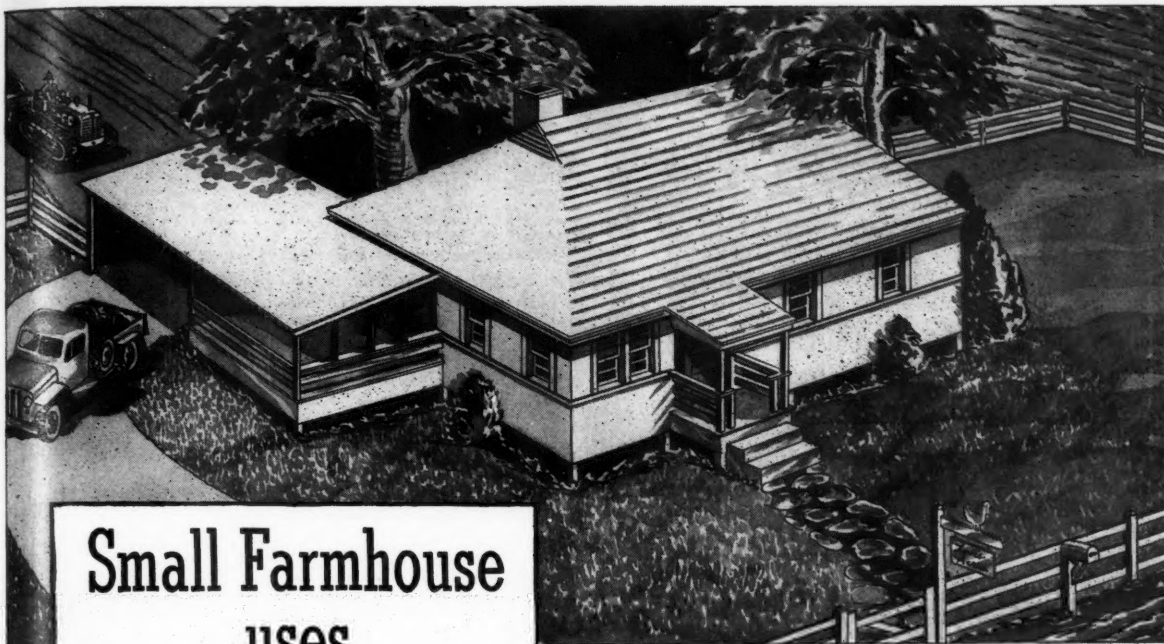
Farm Building Plans. Kentucky Extension Circular 397 (revised February, 1948) (Lexington). A list of plans available for distribution, classified by type of structure.

Making and Feeding Grass and Legume Silage in Western Oregon, by M. G. Huber, Roger W. Morse, and E. R. Jackman. Oregon Extension Bulletin 669 (revised January, 1948) (Corvallis). Emphasizes mechanized operations to provide high-quality silage at low cost.

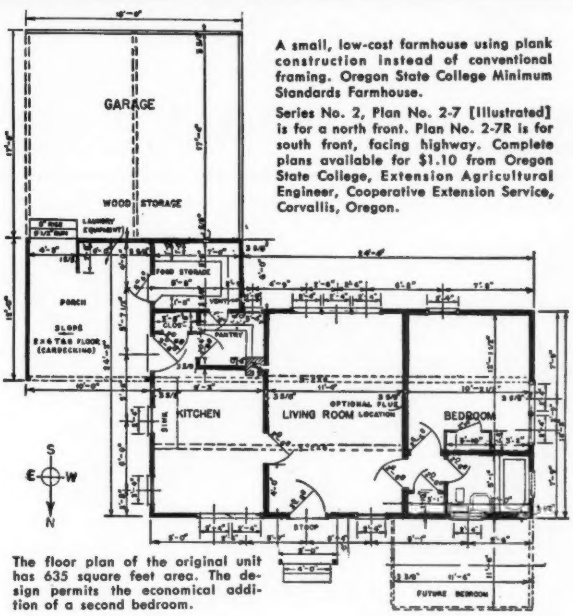
Line-Diagram Method for the Setting of Farm Implements, by William E. Meek and Battle B. Ewing. Circular 138 (February, 1948), Mississippi Agricultural Experiment Station (State College).

PROFESSIONAL DIRECTORY

RATES: Announcements under the heading "Professional Directory" in AGRICULTURAL ENGINEERING will be inserted at the flat rate of \$1.00 per line per issue; 50 cents per line to A.S.A.E. members. Minimum charge, four-line basis. Uniform style setup. Copy must be received by first of month of publication.



Small Farmhouse uses Plywood



A small, low-cost farmhouse using plank construction instead of conventional framing. Oregon State College Minimum Standards Farmhouse.

Series No. 2, Plan No. 2-7 [Illustrated] is for a north front. Plan No. 2-7R is for south front, facing highway. Complete plans available for $1.10 from Oregon State College, Extension Agricultural Engineer, Cooperative Extension Service, Corvallis, Oregon.

The floor plan of the original unit has 635 square feet area. The design permits the economical addition of a second bedroom.

THIS SMALL FARMHOUSE PLAN IS IN THE MINIMUM STANDARD SERIES PREPARED BY OREGON STATE COLLEGE

THE ORIGINAL UNIT of this small farmhouse plan covers 635 square feet exclusive of the open construction in the garage and porch. In this area are kitchen, living room, bedroom and bath—all of ample size for a low-cost house. Special consideration has been given to the problem of farm food storage. Laundry equipment has been placed in a corner of the rear porch, an arrangement suitable to a mild climate. The attached garage and wood fuel storage are convenient features. A second bedroom can be added at any time at minimum expense.

The plank framing used in place of conventional joist and rafter construction is economical where there are local sawmills or where used planks are available. It has a definite advantage also in that it provides additional thermal insulation. Piers instead of continuous foundations reduce costs. Douglas fir plywood is used as finish floors over plank sub-floors, and as exterior and interior wall surfaces.

The design is a refreshing example of "down-to-earth" planning. It combines locally-available and economical, sturdy materials in a construction suitable to the rural mechanics. The result is an attractive, convenient, low-cost modern farm home.

Brief Specifications

FOUNDATION
Concrete piers spaced 6 by 8 feet.

FLOOR
Double 2x6 inch girders. Subfloor of 2x6 inch T & G planking. Finish floor of ⅜" Exterior-type Douglas fir plywood.

WALLS and PARTITIONS
Conventional 2x4 inch studs with 1x6 inch shiplap as exterior sheathing. All interior walls covered with ¼" Interior-type Douglas fir plywood. Outside walls of ¼" Exterior-type Douglas fir plywood horizontally over sheathing. Vertical plank walls covered both sides with plywood might be substituted for stud framing.

CEILING
Tongue and groove planking supported on exposed beams.

ROOF
Plank sheathing from ridge to plate supported by 2x4 inch purlins. Shingle lath and wood shingles.

FINISH
Exterior paint on exterior plywood siding. Interior plywood walls stained, painted or papered. Ceiling stained or painted, or covered with plywood or fiber board.

Douglas Fir PLYWOOD

LARGE, LIGHT, STRONG Real Wood Panels

Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. The Society does not investigate or guarantee the representations made by parties listed. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency, or registration, or license as a professional engineer.

NOTE: In this Bulletin the following listings still current and previously reported are not repeated in detail. For further information see the issue of AGRICULTURAL ENGINEERING indicated.

POSITIONS OPEN: 1947 APRIL—O-552. SEPTEMBER—O-581. DECEMBER — O-604. 1948 JANUARY — O-605, 606. APRIL—O-612, 613, 614, 615. MAY—O-617. JUNE—O-618, 619, 620, 621, 622, 623.

POSITIONS WANTED: 1947 SEPTEMBER—W-119. 1948 JANUARY —W-137. MARCH—W-146, 148, 152. APRIL—W-155, 156, 158, 159, 161. MAY—W-166, 167, 169, 171, 172, 173, 174, 175, 176. JUNE—W-178, 179, 180, 181, 182.

NEW POSITIONS OPEN

AGRICULTURAL MISSIONARY with deep religious experience and interest in lifetime service as foreign missionary for new agricultural and industrial school in Latin America. Teaching simple farm shop, farm mechanics, wood working, soil conservation, and farm machinery are important aspects of work. Some opportunity for extension work and participation in work supervision, building program and other aspects of farm management plan. BS deg in agriculture with major in agricultural engineering preferred. Practical farm experience, vocational teaching, and working with young people in church groups desirable. Housing, medical and family allowances, furlough and retirement provisions. Age 24-33. Salary, $2500. O-624

AGRICULTURAL ENGINEER for work in China, improving present tools and methods of a primitive agriculture, and adapting more modern designs of equipment for use in a system of small land holdings. BS deg in agricultural engineering or equivalent. Practical farming and research experience desirable. Imagination and individual initiative, adaptability to new environment, patience and understanding, for work with people with different culture and customs. Travel, new experience, and possibility of continued work with international agencies. Young man preferred, but other qualifications more important. Housing (including housing for families of married men), food, travel, and incidentals paid. 2 1/6 days per month and 2 weeks sick leave per year allowed. Provident fund (7½ per cent of salary) paid on completion of contract. Salary up to $5,750 (U.S.) for man with right qualifications. O-625

SALES ENGINEER (or trainee) for calls on distributors of established line of disk blades, sweeps, and other tillage equipment, in middle west. Travel by car. BS deg in agriculture or engineering. Experience in sales or service of tillage tools desirable. Good opportunity for advancement to sales or engineering executive. New department of company over 70 years old, with top financial rating and splendid reputation. Age 25-35. Salary open. O-626

ASSISTANT ENGINEER for experimental work, tool and die making, and other engineering in plant building farm equipment and attachments, in Midwest. BS deg in agricultural engineering or equivalent. Experience in design, manufacture, and use of farm equipment desirable. Conscientious, reliable, energetic worker wanted. Good opportunity for advancement as company is enjoying phenomenal growth. No age preference indicated. Salary open. O-627

JUNIOR EXPERIMENTAL ENGINEER for seeding, planting, and fertilizing equipment plant of established full-line manufacturer in Midwest. BS deg in agricultural or mechanical engineering, or equivalent. Farm background with experience in repair and maintenance of farm equipment. Interest in agricultural developments, ability to work with others, ability to make contacts inside and outside of plant for necessary information, and desire to accept responsibility. Good opportunity as engineering department is expanding and placing increasing emphasis on experimental work. Age 22-35. Salary, $2700-3400. O-628

ENGINEERS (2 P-1 rating and 1 P-2 rating) for soil and water conservation work in federal agency. Location—Pacific Northwest. BS deg in engineering, or equivalent. One or more years experience required for P-2 rating, preferably in soil and water field. Other requirements and opportunities normal for professional engineering work under provisions of U. S. Civil Service. Salary, P-1, $2644.80; P-2, $3397.20 to start. O-629

DESIGN ENGINEER to head planter and cultivator division in experimental engineering department of established full-line manufacturer in Midwest. BS deg in agricultural or mechanical engineering desirable but not absolutely necessary. Minimum of 5 yr experience in actually designing cultivators, planters, and middle-busters. Ability to handle small group of men in directing the design and building of experimental machines. Age 40 or under. Salary open. O-630

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER desires research, sales, service, teaching, or project engineering in farm structures or soil and water field. BS deg in physics, 1936; MS deg in agricultural engineering, 1939; PhD deg in agricultural engineering 1943, Cornell University. Teaching agricultural and civil engineering subjects, and boundary and topographic surveying practice (part time), 12 yr. No disability. Available now. Married. Age 34. Salary $5000. W-183